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Current Issues Related to Iron Status: Implications for Nutrition Education and Policy

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This paper provides an overview of the current iron status of the U.S. population. The most prevalent nutrient deficiency in the United States is iron deficiency. Factors potentially associated with iron deficiency are discussed, such as low income, homelessness, pregnancy, vegetarianism, and participation in endurance sports. Females in their childbearing years are not attaining their Recommended Dietary Allowance for iron. A number of factors contribute to the iron intakes of Americans, such as the iron content of the U.S. food supply, individual dietary patterns, and the use of supplements. About 1 in 5 Americans take either a multivitamin and mineral supplement or supplemental iron. There are health risks associated with low iron status, as well as with iron overload. Numerous recent studies are cited, and implications for nutrition education and policy are discussed.

The importance of iron to human health has been acknowledged since the 19th century *(14)*. Why, then, is there suddenly so much controversy about our need for iron? On the one hand, the latest report from the National Nutrition Monitoring System identifies low intakes of iron as an issue of concern *(20)*. On the other hand, several researchers have recently asserted that high intakes of iron may pose health risks. The purposes of this paper are to present an overview of current information related to iron, to attempt to reconcile seemingly conflicting viewpoints about its relationship to health, and to discuss the implications for nutrition education and policy.

Iron's Role in Human Physiology

The body of a healthy adult contains between 3 and 4 grams (g) of iron. Iron is vital to cellular respiration and therefore is present in all cells of the body, primarily as a part of hemoglobin, myoglobin, and various enzymes. Iron not in use is stored as a part of either one of two iron storage compounds, ferritin and hemosiderin *(6)*.

The body's need for iron varies depending on age and physiological state. It is particularly high during periods of rapid growth, such as the prenatal period, infancy, and adolescence, and in women during their childbearing years. Recommended Dietary Allowances (RDAs) established by the Food and Nutrition Board of the National Academy of Sciences *(37)* take these factors into consideration when establishing RDAs for different age-sex groups (table 1).

Iron deficiency is the most prevalent nutrient deficiency in America. It is defined as occurring in three stages: first, depletion of iron stores; second, decreased circulating iron (measured by serum iron or by transferrin, a protein that transports iron in the blood); and third, by iron deficiency anemia, the stage at which deficiency is so marked that the body is unable to make adequate amounts of hemoglobin *(20)*. Other factors may cause anemia; however, iron deficiency is its most common cause *(20)*. The effects of iron deficiency include fatigue, headache, irritability, and decreased exercise efficiency and work performance *(27)*.

Some of the most serious concerns related to iron deficiency are its effects on the health and development of infants and children. These effects appear to begin during the prenatal period. Low hemoglobin or very low hematocrit levels of the mother during pregnancy are associated with limited fetal growth, more common prematurity, and more frequent neonatal death. Unfavorable pregnancy outcomes are similarly increased when hemoglobin and hematocrit levels are high *(54)*.

Table 1. Recommended Dietary Allowances for iron

Category	Age (years) or condition	Iron (mg)/day
Infants	0.0–0.5	6
	0.5–1.0	10
Children	1–3	10
	4–6	10
	7–10	10
Males	11–14	12
	15–18	12
	19–24	10
	25–50	10
	51+	10
Females	11–14	15
	15–18	15
	19–24	15
	25–50	15
	51+	10
Pregnant		30
Lactating	1st 6 months	15
	2nd 6 months	15

Source: National Academy of Sciences, National Research Council, Food and Nutrition Board, 1989, Recommended Dietary Allowances (10th ed.), National Academy Press, Washington, DC.

Risks to infants and children from iron deficiency are primarily associated with cognitive development and function. Infants with iron deficiency anemia have been shown to score lower on tests of mental and motor development than comparable nonanemic infants. The extent of damage to behavioral and cognitive function appears to worsen with duration of anemia. Moreover, there is evidence that the effects of iron deficiency at young ages can persist, leading to impairment in such areas as general intelligence, language capabilities, fine and gross motor performance, visual-motor integration, and school readiness. Since ability in these areas is an important predictor of future achievement, these effects may have lifelong consequences *(31, 60)*.

Older children with iron deficiency also appear to suffer negative cognitive effects. Pollitt *(41)* reviewed the effects of iron deficiency in preschool- and school-age children 3 to 13 years old and found anemia also to be associated with learning difficulties in this older age group. Finally, in addition to its own effects on development, iron deficiency appears to enhance lead absorption by children and can thus exacerbate the negative effects of childhood lead poisoning, which also causes developmental damage *(67)*.

The severity of iron deficiency needed to negatively affect health is debatable. The association of negative health effects with iron deficiency anemia is well established, but there is some evidence that even earlier stages of iron deficiency, not severe enough to produce anemia, may have negative health effects such as impaired physical performance. Rowland et al. *(44)* found that the athletic performance of nonanemic iron-deficient female adolescent runners was improved when their iron deficiency was corrected.

Another area of controversy is the precise definition of iron deficiency in different population groups. In particular, Blacks have been found to have lower hemoglobin levels than Whites while having normal levels on other measures such as dietary iron intake and levels of stored and circulating iron *(40)*. The criteria for anemia in Blacks are therefore uncertain *(20)*.

As with other nutrients, there is an optimal range for iron intakes *(19)*. Iron should be consumed in amounts sufficient to meet physiological needs and to maintain some iron in stores to meet additional requirements that may be imposed (e.g., by blood loss, etc.). However, whereas too little iron has negative health effects, too much is toxic *(27)*. Iron poisoning, caused by ingestion of large amounts of iron at one time, is one of the most common causes of poisoning, especially among preschoolers *(14)*. The Food and Drug Administration has repeatedly urged parents to keep iron-containing vitamin-mineral supplements out of the reach of children to avoid such accidents.

About 1 million Americans suffer from hemochromatosis, a hereditary genetic disorder associated with increased iron absorption and resulting in iron overload *(62)*. Over time, this condition can cause liver and heart failure due to excess iron deposition *(14)*. About 10 percent of the population have been estimated to carry a gene for iron overload without suffering from the disease itself *(27)*. The gene has recently been identified and work is underway to develop better screening tests for the disorder *(62)*.

Iron overload can also be caused by repeated blood transfusions, massive excess intake of iron, or some rare metabolic disorders. In addition, folate or vitamin B-12 deficiency can also cause iron to accumulate in serum and body stores (because lack of vitamins essential to formulation of hemoglobin results in iron not being utilized). Nevertheless, historically, concerns about excess iron intakes have been limited to a very small proportion of the population.

Recently, however, concern has mounted that "high-normal" iron status—that is, higher than average amounts of iron in the body but amounts that are still below toxic levels *(6)*—may have negative effects on health, possibly increasing risk of coronary heart disease and cancer. This is an emerging area of research and one of some controversy.

The hypothesis has been advanced that elevated iron levels promote oxidation of low-density lipoprotein (LDL) and that oxidized LDL plays a major role in the development of arteriosclerosis, a major risk factor for coronary heart disease *(36)*. A Finnish study by Salonen and colleagues *(47)* examined whether excess body iron, as indicated by the serum ferritin concentration (a measure of iron stores), is a significant risk factor for acute myocardial infarction (AMI). They found a 2.2-fold adjusted risk for AMI in men with an elevated serum ferritin, second only to smoking as a risk factor for AMI. Also, dietary iron was positively associated with increased AMI risk in this study—for each 1 milligram of iron consumed daily, there was an increment of 5 percent in associated AMI risk *(47)*. A study of almost 45,000 U.S. men found that the incidence of fatal coronary disease or nonfatal AMI was higher in those with the highest intake of dietary heme iron, which is known to be a significant determinant of iron status *(3, 11)*.

Not all of the evidence indicates an association between iron and cardiovascular risk, however. A number of studies of American populations have found no increased relative risk associated with excessive dietary intake or high levels of iron in the blood *(4, 19, 49, 50)*. Also, analysis of NHANES I Epidemiologic Follow-Up Study data found an inverse association between dietary iron and coronary heart disease morbidity and mortality *(22, 29)*.

Several researchers have also theorized that high body iron stores may increase the risk of cancer. It is hypothesized that iron stores either catalyze the production of free radicals, and thereby damage DNA, or act as a limiting nutrient for the growth of cancer cells *(11, 53)*. To date, research on the subject has yielded inconclusive results. It has been suggested that if excess iron is carcinogenic, individuals with hereditary iron overload would be likely to suffer from higher cancer rates. However, except in the case of liver cancer, there seems to be no convincing evidence of this *(34)*.

Epidemiological studies among the normal population have shown some association between higher circulating iron levels (transferrin saturation) and cancer risk, at least for some forms of cancer and in some populations. Stevens et al. *(53)* found that among a group of Americans followed for 10 years, men with higher levels of transferrin saturation had a greater incidence of cancer mortality. However, no relationship between iron and cancer was found for women.

In a follow-up study, a relationship between transferrin saturation and cancer risk was found in women as well as men *(52)*. Knekt et al. *(28)* found a positive relationship between transferrin saturation and some forms of cancer but an inverse relationship of transferrin saturation to stomach cancer. In interpreting these results, it is important to realize that an observed association is not proof of a causal relationship between iron and cancer. Alternative explanations must be ruled out. For example, it is important to recognize that disease processes themselves may affect levels of common physiological measures of iron status; thus, an observed relationship may have nothing to do with previous iron status *(69)*.

Given the conflicting findings obtained to date, the answer to the question of whether there really is an association between iron and either cancer or coronary heart disease is still in doubt *(34, 50)*. One possible means of resolving the question would be to conduct a more controlled randomized trial of the effects of iron supplementation. However, this would be time-consuming and expensive and might raise ethical questions. A more feasible alternative may be to continue examining data from observational studies in a wide range of populations and see if a consensus gradually emerges *(5)*.

Iron Intakes of Americans

With these recent concerns emerging and controversy making its way into the popular press *(2, 48)*, it is useful to examine how the American food supply, individual dietary patterns, and use of vitamin-mineral supplements contribute to the iron intakes of Americans and to consider the implications for iron status.

Specific foods vary considerably in their iron content. The most recent edition of the *Dietary Guidelines for Americans*, the official statement of Federal dietary guidance policy, includes a list of foods that are particularly good sources of iron (see box below). This iron may be naturally occurring or may have been added to enriched or fortified foods. Enriched grains contain iron added in amounts specified by the Food and Drug Administration *(66)*. Fortified foods may have iron and/or other nutrients added in varying amounts *(59)*.

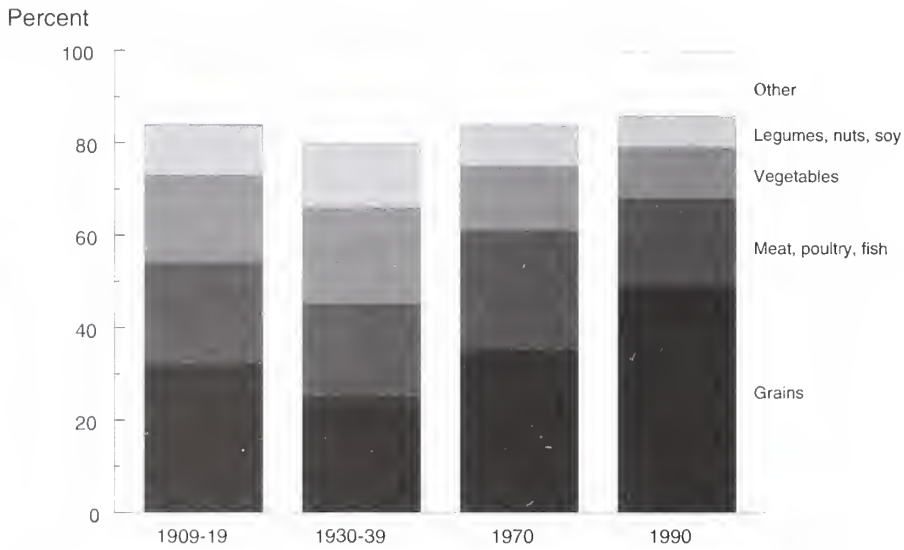
The importance of specific foods as iron sources depends not only on their iron content but also on how commonly they are eaten—for example, both oysters and bread are good sources of iron, but few individuals eat oysters as frequently as bread; therefore bread tends to be a more important source of iron in the diet. Information from the USDA's data series *Nutrient Content of the U.S. Food Supply (24)* indicates which foods are major sources of iron for Americans.

Some Good Sources of Iron

* Meats—beef, pork, and lamb and especially liver and other organ meats
* Poultry—chicken, duck, and turkey, especially liver and dark meat
* Fish—shellfish like clams, mussels, and oysters; sardines, anchovies, and other fish
* Leafy greens of the cabbage family, such as broccoli and kale: turnip greens, collards; lima beans, green peas; dry beans and peas such as pinto beans, black-eyed peas, and canned baked beans
* Yeast-leavened whole wheat bread and rolls

There has been an upward trend in the iron content of the food supply in recent years...

Figure 1. Sources of iron in the U.S. food supply, selected years, 1909-90



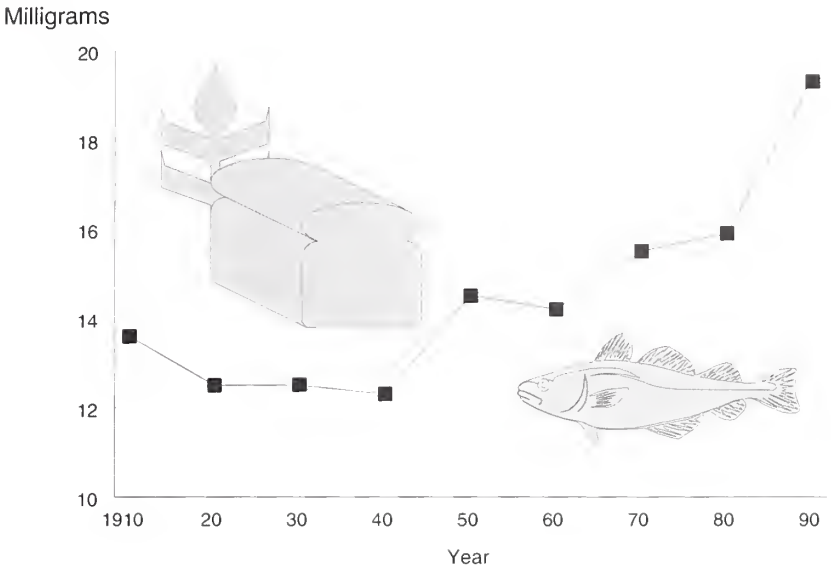
Source: Gerrior, S.A. and Zizza, C., 1994, Nutrient Content of the U.S. Food Supply, 1909-90, Home Economics Research Report No. 52, U.S. Department of Agriculture.

This data series estimates the amount of nutrients per capita per day in food that is available for consumption nationwide. Food supply nutrient per capita values represent the amount of nutrients in foods that disappears into the marketing system. These values exceed the amount ingested because losses from trimming, cooking, waste, and spoilage are not measured *(24)*. Results are used to monitor the potential of the food supply to meet the nutritional needs of the population, track historical trends, and evaluate changes in the American diet.

In 1990, the level of iron available in the U.S. food supply was 19.3 mg per capita per day, 49 percent of that from grains; 19 percent from meat, poultry, and fish; and the remainder from other sources (fig. 1). There has been an upward trend in the iron content of the food supply in recent years (fig. 2) for several reasons. One reason is that in 1983 there was an increase in the standard used for iron enrichment of white flour. In addition, there has been a gradual rise in the percentage of white flour being enriched—from about 65 percent in the mid-1960's to 95 percent in the early 1990's *(24)*. A trend toward increased iron fortification of breakfast cereals has also been observed *(19)*. Finally, the usage of grains has increased *(24)*.

At 19.3 mg per capita per day, the average iron content of the food supply exceeded recommendations for all sex-age groups with the exception of pregnant women. This does not mean,

Figure 2. Iron per capita per day in the U.S. food supply, selected years, 1910-90



Source: Gerrior, S.A. and Zizza, C., 1994, Nutrient Content of the U.S. Food Supply, 1909-90, Home Economics Research Report No. 52, U.S. Department of Agriculture.

however, that all Americans ingest recommended amounts of iron, since food supply estimates may be higher than amounts available for consumption. Also, food intake patterns vary and some individuals may consume lower-than-average amounts of iron. To assess individual dietary intake patterns and identify areas of concern, the Federal Government also conducts large national surveys that obtain information on individuals' food and nutrient intakes.

According to estimates from USDA's 1994 Continuing Survey of Food Intakes by Individuals (CSFII), Americans as a whole consume an average of 136 percent of their RDA for iron. However, while male adults are getting 182 percent of their RDA, female adults 20 to 49 years of age are consuming only 82 to 88 percent of their RDA, on average *(55)*.

Data from the National Health and Nutrition Examination Survey (NHANES III), conducted by the National Center for Health Statistics of the U.S. Department of Health and Human Services (DHHS) in 1988-91, provided similar findings. Mean daily iron intakes[1] were 15.5 mg for infants, 9.5 mg for 1- to 2-year-old children, and ranged between 11.9 and 16.0 mg for all other age groups. Male adolescents and adults had consistently higher mean iron intakes than females (table 2).

[1]Iron estimates are very skewed because food and nutrient intake varies from day to day. Iron consumption may be very high or low for some people on specific days, influencing population means.

Age-specific mean iron intakes met or exceeded the RDA for infants and children ages 3 to 11 years, but not for children ages 1 to 2 years. Whereas all adolescent and adult males' mean iron intakes met the RDA, the only females that met the RDA were those ages 51 and over *(1)*.

These estimates represent iron obtained from food only. Iron is also obtained by many individuals as a supplement, either singly or as a part of a multivitamin/mineral supplement. Unfortunately, less is known about the contribution of iron supplements to intake. Some data are available on the use of multivitamins with minerals, which typically contain iron, and iron supplements.

According to the 1994 CSFII, 16 percent of the population take a multivitamin with iron and/or other minerals, and 6 percent take supplemental iron, either singly or with vitamin C added. Pregnant women are the most likely population subgroup to take one of these supplements (table 3), which accords with current advice from the *Dietary Guidelines for Americans* recommending iron supplements for pregnant women *(58)*. These data give some idea of the prevalence of supplemental iron ingestion among various demographic groups but do not provide quantitative information on the amount of iron consumed from supplements. More needs to be known about consumption of supplemental iron.

Assessment of the adequacy of iron intakes is further complicated by the fact that not all iron ingested is absorbed, and the amounts actually absorbed can vary considerably from individual to individual. Two major factors influence how much iron is actually absorbed and utilized by the body: physiological need

and bioavailability of ingested iron. Actual absorption of iron can vary from less than 1 percent to more than 50 percent depending on the combination of these factors *(14)*.

The body adapts to absorb more iron when more is needed. When body iron stores become depleted, iron absorption increases *(12)*. Iron absorption also increases when the rate of red blood cell formation is increased, as with pregnancy *(6)*. Individuals may have a "set point" above which regulatory mechanisms adapt to limit further increases in stores *(23)*, but whether this is true and whether it acts sufficiently to limit "high-normal" amounts of storage iron that may be associated with coronary heart disease and cancer remains to be established.

Bioavailability is defined as the amount of a nutrient biologically available and takes into consideration such factors as absorbability of the form of the nutrient and effects of other dietary factors on absorption. Many factors affect the bioavailability of iron in the diet. One major factor is the form of iron consumed. Dietary iron is roughly divided into two major categories: heme and nonheme iron. Heme iron comprises 40 percent of the iron in meat, poultry, and fish, the remainder being nonheme iron. The iron in dairy and plant foods is nonheme iron, which provides over 60 percent of total dietary iron. Although heme iron makes up a smaller part of the iron in the food supply, it is more readily absorbed than nonheme iron and its absorption is not impaired by most inhibitory factors. Nonheme iron absorption, however, is affected by a number of dietary inhibitors and enhancers *(13)* (see box on p. 10).

Table 2. Daily iron intake in milligrams by age and sex, United States, 1988-91

Age	All	Male	Female
All ages	14.70	17.17	12.37
2 - 11 months	15.50	15.89	15.10
1 - 2 years	9.53	9.74	9.29
3 - 5 years	11.86	12.47	11.23
6 - 11 years	13.76	14.54	12.96
12 - 15 years	15.98	19.51	12.26
16 - 19 years	15.61	18.64	12.52
20 - 29 years	15.12	17.87	12.43
30 - 39 years	15.91	19.16	12.73
40 - 49 years	15.05	18.18	12.05
50 - 59 years	14.41	17.25	11.84
60 - 69 years	14.64	16.59	12.97
70 - 79 years	14.06	15.84	12.77
80 years and over	13.31	16.22	11.76

Source: Alaimo, K. et al., 1994, Dietary intakes of vitamins, minerals, and fiber of persons ages 2 months and over in the United States: Third National Health and Nutrition Examination Survey, Phase 1, 1988-91, Advance Data No. 258, U.S. Department of Health and Human Services, Public Health Service.

Absorption of nonheme iron has been found to be enhanced by vitamin C; a substance in meat, poultry, and fish; and by citric, malic, lactic, tartaric, and other organic acids. It is inhibited by a number of compounds, including the phosphoprotein in eggs; bran; soy protein; high levels of zinc; coffee; phytates found in cereals, nuts, and legumes; and polyphenols found in tea, vegetables, legumes, and red wine *(6, 26)*. Calcium has been found to inhibit both heme and nonheme iron absorption *(26)*. Consuming calcium as part of a meal or with multivitamin-mineral supplements has been reported to inhibit the absorption of iron ingested at the same time by as much as 50 percent *(64)*.

How all these factors combine to affect the bioavailability for iron in the typical American diet is an important question to consider when assessing iron status. A study by Cook et al. *(12)* indicates that iron absorption from self-selected meals with contents reasonably typical of a varied "Western" diet was not significantly different from iron absorption from meals designed to enhance absorption. Instead, most of the variation in iron absorption was due to iron status as measured by serum ferritin. The bioavailability of dietary iron is probably more of a problem in developing countries where most iron comes from plant sources and diets often contain a much higher proportion of inhibiting factors *(6)*.

Table 3. Use of multivitamin-mineral supplements and supplemental iron, by sex-age groups, 1994

Sex-age groups	Percent taking multivitamin with iron and/or other minerals	Percent taking supplemental iron[1]
All individuals 1 year and above	16	6
Children 1 - 6 years	22	4
Children 7 - 10 years	12	4
Male 11 - 18 years	7	5
Males 19 - 50 years	12	6
Males 51 years and over	12	4
Females 11 - 18 years (nonpregnant)	8	10
Females 19 - 50 years (nonpregnant)	22	8
Females 51 years and over	18	6
Pregnant females[2]	64	10

[1]Iron taken as single nutrient or iron-vitamin C compound.
[2]Unweighted sample size = 33. Because of the small cell size, this estimate may be less statistically reliable than other estimates presented.

Source: U.S. Department of Agriculture, Agricultural Research Service, 1996, 1994 Results from the Continuing Survey of Food Intakes by Individuals and the Diet and Health Knowledge Survey.

Iron Status of the American Population

Population survey data provide information on the prevalence of iron deficiency in the American population. Historically, some population groups are known to be particularly at-risk for iron deficiency, and nutrition monitoring efforts have emphasized assessment of the iron status of these groups.

Biological factors place some groups at particular risk for deficiency. Among these are infants and preschool-age children, adolescents, women in their childbearing years, and pregnant women. In addition, socioeconomic factors such as poverty and homelessness can exacerbate risk. Behavioral factors such as vegetarianism and participation in endurance athletics have also been found to pose risks for iron status *(17)*.

Infants and preschool-age children from about 6 months to 4 years of age are at particular risk for iron deficiency because of the demands of growth and development. The body reserves of iron with which an infant is born usually cannot meet physiological needs beyond 6 months. After that period, because the body is experiencing rapid growth, iron needs are quite high relative to total energy intake *(15)*.

For infants, either breast milk or formula is typically the major food source. Human breast milk has less than one-sixth the iron concentration of the typical adult diet; however, an unusually high percentage of the iron in breast milk is absorbed *(15)*. It is recommended that if formula is used, one that is iron-fortified be chosen. Iron-fortified cereal can also be important in helping meet iron needs, particularly in the second year of life, when the child moves from breast milk or formula to cow's milk, which is low in iron.

NHANES II data, collected between 1976 and 1980, indicate that for the U.S. population, the prevalence of iron deficiency was estimated at about 9 percent in infants age 1 to 2 years. Subsequent findings from clinics that participate in Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) and in private practice settings have indicated a considerable decline in iron deficiency anemia in infants and preschool children. For example, Yip et al. *(68)* reported finding a steady decline in the prevalence of anemia among low-income children in six surveyed States, going from 7.8 percent in 1975 to 2.9 percent in 1985. Other findings from a middle-income population study showed the prevalence of anemia among children ages 9 to 23 months declined from 7 percent between 1969 and 1973 to under 3 percent between 1982 and 1986 *(19)*.

A recent analysis of NHANES III data *(16)*, however, showed no trend to reduction in the prevalence of anemia among either infants or children. These contradictory results may be explained by the fact that the previous studies include data from local samples derived from clinical populations. The resulting nonrandom sample may overrepresent improvement because local conditions are not representative of the national situation or because it represents only children reached by public health or

clinical care. Whatever the reason, the NHANES III data are disappointing, given the previous indications that improvement had been made in relationship to this at-risk group.

Early adolescence is also a period of rapid growth and increased iron needs because of expanding red blood cell mass and the need to deposit iron in myoglobin. The iron needs of female adolescents are particularly high as they enter female reproductive years, because of menstrual iron loss *(15)*. NHANES III data (1989-94) indicate a prevalence of iron deficiency of 8-13 percent among adolescent females *(16)*. The *Dietary Guidelines for Americans* recommend that teenage girls should eat enough iron-rich foods, such as lean meats and whole-grain or enriched bread, to keep the body's iron stores at adequate levels *(58)*.

Higher iron needs for women continue throughout their childbearing years. Among women 20 to 49 years of age, NHANES II (1976-80) data indicated that about 10 percent were iron-deficient and about half of this group had iron deficiency anemia. NHANES III data (1989-94) indicate no decrease since then *(16)*.

A time of particularly increased demands is pregnancy, when iron is needed to meet the demands of the mother's expanded blood volume, the needs of the fetus and placenta, and blood losses during childbirth *(37)*. Data collected in 1992 as part of the Pregnancy Nutrition Surveillance System of the Centers for Disease Control (CDC) indicated that by the third trimester of pregnancy, 29 percent of women were anemic *(20)*. Anemia was most common among non-Hispanic Black women (43 percent) and in pregnant adolescents less than 16 years of age (38 percent). CDC data indicate no improvement in the iron status of low-income pregnant women since 1989 *(19)*.

Low income has been shown to be associated with increased prevalence of iron-deficiency anemia in physiologically vulnerable populations. An analysis of NHANES II data indicated the prevalence of iron-deficiency anemia among low-income children to be almost twice that of other children. Poorer diets may be a factor in this difference. Rose et al. *(43)* found low income to be associated with decreased iron intakes by preschool-age children.

Homelessness has also been found to be a risk factor. Fierman et al. *(21)* found that homeless infants and children living in emergency shelters had higher rates of iron deficiency than other children living in poverty. Drake *(18)* found about one-quarter of a sample of homeless women and their children who were living in shelters in Kansas City suffered from iron-deficiency anemia.

Behavioral factors can also influence risk of iron deficiency. One factor whose effect on iron status has been frequently studied is vegetarianism. Vegetarians tend to have reduced iron stores, which are associated with an increased risk of iron deficiency. The main sources of dietary iron for vegetarians are whole-grain and fortified cereals, legumes, dark-green vegetables, nuts, seeds, and dried fruit *(13)*. Since meat, poultry, and fish are major contributors of iron in most American diets, vegetarians should pay special attention to this nutrient *(58)*. This is especially true

Factors That Influence the Absorption of Nonheme Iron (Adapted from 13, 26, 35)

Substances that inhibit nonheme-iron absorption
- Phytates
- Plant polyphenolics
- High dietary amounts of zinc
- Soy protein
- Egg
- Tea and coffee
- Bran

Substances that inhibit heme- and nonheme-iron absorption
- Calcium

Substances that enhance nonheme-iron absorption
- Ascorbic acid
- Meat, poultry, and fish
- Citric, malic, lactic, tartaric, and other organic acids
- Fermentation products of soybean
- Other factors
  - Low iron content of meals
  - Iron in ferrous form

Factors that enhance heme- and nonheme-iron absorption
- Low iron stores of individuals

for vegetarians who are part of physiologically at-risk groups such as children and women of childbearing age. With appropriate planning, however, vegetarian diets can provide adequate iron.

Participation in endurance athletics, especially by women, has been found to be associated with increased risk of iron deficiency. Long-distance runners and other endurance athletes are prone to iron deficiency, which may impair their athletic performance. Young female athletes have an above-average risk of iron deficiency because they face the combined effects of rapid growth, menstrual blood loss, and increased iron losses associated with heavy endurance training *(61)*. Studies show that as many as 40 percent of young female athletes have low or extremely low serum ferritin concentrations. Some authorities have recommended an iron status assessment for all "seriously committed" female athletes *(17, 33)*.

Whereas the prevalence of iron deficiency has been studied extensively, the prevalence of "high-normal" levels of iron has been less studied. Only recently, with the emerging controversy concerning potential risks of "high-normal" iron levels, has there been an interest in examining this phenomenon. Currently, there is controversy about whether the data indicate a trend toward higher levels of storage iron in the American population. When NHANES II (1976-80) data on serum ferritin levels that measure the amount of iron stored in the body were compared with data from the 1982-84 Hispanic Health and Nutrition Examination Survey (HHANES), serum ferritin levels were higher for Hispanic individuals from HHANES than for either non-Hispanic Whites or Hispanics from NHANES II. This was especially true for males. When a further comparison was made with data from pilot studies for NHANES III that were conducted in 1987 and 1988, serum ferritin levels for both Hispanic and non-Hispanic White males who participated in the pilot study were similar to those for Hispanic males who participated in HHANES *(30)*. These results may indicate that iron stores have increased, at least among males. It is also possible, however, that the difference may reflect changes in methods for determining serum ferritin during the period between the two surveys. Therefore, the question of whether the prevalence of "high-normal" levels of iron is increasing, as well as the larger question of whether there are any negative health effects of "high-normal" levels, remains unsettled.

Current Public Policy and Educational Activities Addressing Iron Status

Given that the prevalence of iron deficiency and its negative health consequences have long been known, it is not surprising that improvement of iron status has received considerable attention as a part of public health policy. Iron is identified as a nutrient of concern by the National Nutrition Monitoring System *(20)*.

The Department of Health and Human Services (DHHS) has included an objective among its Healthy People 2000 objectives for the Nation for decreasing the prevalence of iron deficiency *(59)*. The 1995 edition of the *Dietary Guidelines for Americans,* the official statement of Federal nutrition policy, includes information on the need for iron, especially among vulnerable groups, and good food sources of iron. The new "Nutrition Facts" labels that

Whereas all adolescent and adult males' mean iron intakes met the RDA, the only females that met the RDA were those ages 51 and over.

are now required on virtually all packaged foods require information on iron content.

Public policy efforts to reduce iron deficiency have employed a variety of strategies. These include improvement of the food supply via enrichment of grains with iron, inclusion of activities addressing iron status as part of programs directed toward population groups vulnerable to iron deficiency, and provision of education and information to the general population.

Enrichment of grain products with iron and other nutrients dates back to the 1940's. Appropriate iron addition levels for enriched grain products are specified by standards of identity defined by the Food and Drug Administration *(66)*. These standards have been periodically revised since the 1940's; the last revision took place in 1983. In 1990, 95 percent of grain products in the food supply were enriched *(24)*.

Food assistance programs directed toward special populations have been important as a means of improving the iron status of high-risk groups. Especially noteworthy is USDA's WIC program. WIC provides a combination of direct nutritional supplementation, nutrition education, and increased access to health care and social service providers for low-income pregnant, breast feeding, and postpartum women; infants; and children up to the age of 5 years. One of its major goals is to reduce the incidence of anemia among these high needs populations. WIC services are delivered in each of the 50 States, the District of Columbia, Puerto Rico, Guam, and the American Virgin Islands. Additionally, many Indian tribal organizations serve as State WIC agencies, for a total of 86 State WIC agencies. In 1995, program participation averaged 6.9 million *(32)*.

Program benefits include provision of foods selected for their iron content. For adults and children, these foods include iron-fortified cereals (at least 28 mg iron/100 grams of dry cereal) and juices that are rich in vitamin C, which enhances iron absorption. The packages for children and pregnant and breastfeeding women also include dried beans, which are good sources of iron. Formula may be provided to infants; WIC requires that formula be iron-fortified (at least 10 mg iron/L standard dilution formula). Infants 4 to 12 months of age may also receive iron-fortified infant cereals (at least 45 mg iron/100 grams of cereal) and vitamin C-rich fruit juices.

In addition, there is a strong educational component to WIC. Federal regulations require that each recipient participate in at least two nutrition education sessions during each certification period (usually 6 months) and that nutrition education focus on specified target nutrients, including iron *(42)*. Therefore, the need for iron and good food sources of iron are topics that would be expected to receive considerable attention as part of WIC nutrition education sessions.

To receive WIC benefits, an individual must be a member of one of the population groups served, have a low income (no more than 185 percent of Federal poverty level), and be at nutritional risk. Risk criteria, including those measuring iron status, are set at the State level. The National Association of WIC Directors urges States to follow standard guidelines, such as those published by the Centers for Disease Control *(38)*.

Based on data from the 1992 Study of WIC Participant and Program Characteristics *(42)*, 20 percent of WIC participants suffered from anemia at the time of certification (program entry). Among women, 25 percent had anemia, as did 22 percent of children ages 1 to 5 years. Of infants ages 6 to 8 months, 32 percent had low iron measures at certification, as did 27 percent of infants ages 9 to 11 months.

Several studies have provided evidence of the importance of WIC in promoting positive iron status among vulnerable groups. Participation in WIC has been found to decrease the prevalence of anemia among infants *(39)* and children *(68)* and to be associated with increased iron intakes by pregnant women, infants, and children *(7, 43, 45, 46)*.

Other food assistance programs, though less specifically targeted towards improvement of iron status, are also important as a means of ensuring that vulnerable groups, especially low-income groups, obtain diets that contain adequate amounts of iron. Through the USDA's Food Stamp Program, low-income households are able to supplement the funds available to them for food purchasing. Studies show that food stamp households purchase foods that have higher levels of many nutrients, including iron *(65)*. A large proportion of food stamp participant households contain young children, a group vulnerable to iron deficiency. Rose et al. *(43)* found that preschoolers in households participating in the Food Stamp Program had higher nutrient adequacy ratios for iron after controlling for other sociodemographic factors.

The National School Lunch Program (NSLP) and School Breakfast Program (SBP) are important sources of food and nutrients for a large proportion of American children, especially low-income children. On average, 25.3 million children and adolescents received school lunch daily in 1994 *(51)*. More than half of these participants received their meals free or at reduced price. An average of 5.8 million children and adolescents received school breakfast daily, and about 87 percent of these received their meals free or at reduced price *(51)*.

Meal planning guidelines provided to schools by USDA have mandated inclusion of iron-rich foods in school meals. In 1992, USDA conducted the School Nutrition Dietary Assessment Study, which collected information on meals offered and student dietary intakes from a nationally representative sample of schools. Results indicated that school meals generally met or exceeded the RDA standards for essential nutrients. In the case of iron, there was one exception: school lunch meals fell just short of the 33 percent of the RDA standard for 11- to 18-year-old females—lunches averaged 31 percent of the RDA for this group *(8)*. The study also found that adolescent females are less likely than other eligible groups to participate in school meal programs. This is disturbing, since female adolescents are a high-risk group for iron deficiency.

New regulations on school meal planning standards, which became mandatory in July 1996, now require that NSLP lunches should, over time, provide one-third of the RDA for food energy and several essential nutrients, including iron, while also meeting Dietary Guidelines recommendations for fat and saturated fat. SBP breakfasts must meet one-fourth of the RDA *(57)*.

USDA also funds the Child and Adult Care Food Program, which serves children and adults in day-care situations. Currently, it serves 2.3 million children, mainly preschoolers. Adult participation is much lower—39,000. Required food components of meals include such iron-rich foods as breads and grains and meat or meat alternates *(56)*. The adult meal patterns were developed based on RDAs for adults age 51 and older. Currently, research is underway to develop new meal patterns for children *(56)*.

The Nutrition Program for the Elderly, established by the Older Americans Act of 1965 and administered by the DHHS, provides prepared meals to persons at least 60 years old and their spouses regardless of age. The program offers congregate meals as well as "Meals on Wheels" delivered to homebound elderly. Meals must average at least one-third of the RDA for several nutrients, including iron. USDA provides per-meal support to the program in terms of either cash or commodities *(10)*.

For the general public, nutrition education has focused on providing information on iron within the perspective of an overall guide to a healthful diet. There is evidence that relevant nutrition knowledge and attitudes can promote improved iron intake. Rose et al. *(43)* found that preschoolers living in households in which the main meal planner had a positive attitude about the importance of grains in the diet consumed more iron than other children with similar characteristics.

Current dietary advice is embodied in the USDA/DHHS Food Guide Pyramid *(63)*. The Food Guide Pyramid was developed as a means of putting the *Dietary Guidelines for Americans* into practice. One of its goals was to provide a guide to diets that would meet 100 percent of the RDA for iron, as well as other essential nutrients. It encourages consumption of 6-11 servings of enriched and whole grain breads, cereals, rice, and pasta and also recommends 2-3 servings of meat, poultry, fish, dried beans, or eggs daily. These foods are the major sources of iron in USDA sample meal patterns developed using the Pyramid as a guide. The sample meal patterns met the iron RDA for most age-sex groups. Iron may still be a concern for women of childbearing years who eat small amounts.[2] This problem may be addressed by selecting foods high in iron, either natural or fortified, or through the use of an iron supplement, if medically recommended *(63)*.

These public policy initiatives and nutrition education efforts have focused on ensuring adequate intakes of iron, especially among vulnerable groups, since iron deficiency is a well-established health problem. Given that "high-normal" iron status has not been conclusively identified as a health concern, it is not surprising that policy and education efforts have not focused on the issue of whether efforts are needed to control excess iron intakes among some populations, such as adult males and postmenopausal women.

[2]Sample diet patterns based on the Food Guide Pyramid were developed at 1,600, 2,200, and 2,800 calorie levels; only at the 1,600 calorie level did the pattern fail to meet women's RDA for iron.

General nutrition policy, however, has always warned against consumption of amounts of nutrients far in excess of the RDA from supplements or other sources, since amounts above the RDA confer no known benefits and may cause harm. The *Dietary Guidelines for Americans* currently recommend iron supplements only for pregnant women. This is consistent with a conservative position that, although it is premature to draw conclusions regarding "high-normal" iron status and health risk, it is prudent to prescribe iron supplements only for iron deficiency and during pregnancy *(9)*.

Conclusions

It is clear that low iron intakes and resulting iron deficiency remain a public health issue of concern among certain vulnerable groups within the American population. Iron deficiency among pregnant women, infants, and young children is especially disturbing, given the potential long-term impacts on physical and mental development.

Nutrition interventions, such as the WIC Program, that focus on improving iron status among these vulnerable groups appear to be effective in decreasing iron deficiency. Nevertheless, population-level data indicate no decrease in the prevalence of iron deficiency among women, infants, and children over the past decade *(16)*. More needs to be known about how we can make progress in reducing iron deficiency among these vulnerable groups.

In addition, more research on iron's interactions with other nutrients and how those interactions affect bioavailability is needed. The calcium-iron interaction is of particular concern, given that both are nutrients for which low intakes are often a problem among women and given the current trend toward recommending higher levels of calcium intakes by women *(25, 64)*.

The current controversy concerning "high-normal" iron levels and their hypothesized negative health effects raises important policy questions that can only be answered by further research. More research is needed to conclusively establish whether "high-normal" levels of iron in the body do in fact have any links to increased risk of cancer or coronary heart disease.

If the hypothesized negative effects are shown to exist, it will be necessary to more clearly establish an upper-level cutoff for healthy levels of iron in the body and determine the prevalence of individuals with levels above that range in the American population. Should "high-normal" ranges prove to be both dangerous and prevalent in the American population, it will create a considerable challenge for nutrition policymakers and educators. They will be faced with crafting nutrition policies and educational messages that emphasize the need to increase iron intake among some population subgroups and the need to moderate intake among others. Such a complex message would be extremely difficult to translate into action and communicate to the population as a whole.

Based on the current state of knowledge, however, the advice embodied in the 4th edition of the *Dietary Guidelines for Americans* provides the best advice for the general population. Vulnerable groups, including young children, adolescent girls, and women of childbearing age, should be sure to include foods that are good sources of iron in their diets on a regular basis. It is recommended that pregnant women take iron supplements. For other groups, a balanced diet based on the Food Guide Pyramid should provide enough iron without risk of excess, and consumption of iron supplements should be unnecessary.

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The Nutritional Impact of Food Fortification in the United States During the 1970's

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Food fortification is perceived to have played a major role in the elimination of a wide number of deficiency diseases. This study examines how cereal grain fortification has affected the distribution of nutrient intakes of the U.S. population during the 1970's with the use of food intake data collected as part of the 1977-78 Nationwide Food Consumption Survey. For each food consumed for approximately 30,000 individuals, thiamin, niacin, riboflavin, and iron quantities were disaggregated into the amount of added and naturally occurring nutrients. Results indicate a marked upwards shift in the intake distribution associated with consumption of fortified foods for all four nutrients regardless of income, education, or region of residence. This analysis provides strong support for the importance of food fortification as a source of key nutrients in the U.S. diet during the 1970's and also shows that these benefits cut across most sociodemographic barriers.

A wide range of scholars and policymakers in the food and nutrition field have spoken out on behalf of fortification *(1, 3, 13, 14, 18, 26, 27)*. In general, the arguments for fortification focus on the need to control and prevent specific nutrient deficiencies in diets. Moreover, changing food processing and consumption patterns may enhance the need for improvements in nutrient density through fortification.

Deficiency diseases have been eliminated from higher income countries but not from countries where poverty or lack of fortification has limited the translation of modern nutrition knowledge to benefit the population. For instance, deficiency diseases, such as xerophthalmia and goiter (and in a more limited fashion, even beriberi and pellagra), are major public health problems in a few regions of the world, and iron deficiency anemia is highly prevalent in most regions of the world *(16, 28, 30, 31)*.

Nevertheless, in many lower income countries, such as Philippines and Bangladesh, and in a number of higher income countries, such as France, Norway, and Finland, regulations

restrict fortification and enrichment *(7)*. In contrast, Canada and the United States (with clearer and more liberal regulations) are among the countries with a history of food fortification. Such countries are considering whether they should require fortification of their food supply with folic acid since numerous studies have shown that low levels in women of childbearing ages are associated with neural tube defects.

There have been few population-based studies to examine how fortification improves human health. As a pioneer in the effort to expand fortification, Sebrell notes "Everyone acknowledges that the addition of vitamin D to milk has been the major factor in the disappearance of rickets...although there has never been direct proof that this is so" *(24)*. Sebrell felt that it has been virtually impossible to unravel the changes in food prices, incomes, food availability, and enrichment, inter alia *(24)*. Changes in food habits, economic growth, and fortification all have contributed greatly to the reduction in the number of deaths from pellagra *(20, 22)*.

Specific supplementation studies such as those undertaken with the provision of fortified beverages or cereal to children or grain products to older persons have been highly successful *(9, 11, 25)*. Studies on beriberi in the Philippines showed quite convincing effects of thiamin enrichment of rice *(23)*. One of the most sustained research efforts concerned the addition of lysine and other amino acids to cereal grains in Thailand, Japan, and North Africa. The results were quite variable, but only in Japan was it found that growth or other nutritional status indicators were significantly improved by fortification *(10)*.

Terminology

There are four terms that are often used synonymously to encompass nutrient addition. The first is enrichment, which is the addition of nutrients to levels specified in standards of identity. The second is restoration, which is the addition of nutrients to a food to compensate for losses of nutrients during processing. The third is the term "fortification" itself, which is the addition of nutrients at levels higher than those found in the original or comparable food and is focused more on providing adequate levels to effectively prevent disease *(24)*. More recently, the term "nutrification" has been introduced as an all-inclusive term covering the prior nomenclature. In practice, it is very difficult to distinguish between the added nutrient methods used for various food products. In this paper, the term "fortification" is used generically to describe enriched, restored, and fortified foods.

Surprisingly, there is little other research that examines the effect of fortification and enrichment on dietary adequacy. Cook and Welsh *(5)* prepared a key study that examined how the food supply and average nutrient intake of a number of nutrients has been affected by enrichment and fortification. They showed that fortification and enrichment of grain products combined to provide a significant proportion of the thiamin (32 percent), niacin (20 percent), iron (19 percent), and riboflavin (18 percent) supply for the average American in 1977-78. For all foods that were fortified, they created a nutrient data file that separated the components of each nutrient into naturally occurring and added.

Other researchers have examined aspects of dietary behavior that relate to fortification of ready-to-eat cereals *(32)* and niacin, vitamin C, and riboflavin *(29)*. Recently, Crane et al. *(6)* simulated the effect of folic acid fortification of the U.S. food supply of cereal-grain-based products and found increases in folate intakes of consumers at the higher end of the distribution curves to be greater than those of consumers at the lower end.

Using a population-based approach and the data base developed by Cook and Welsh *(5)*, we examined the effects of food fortification with iron, riboflavin, niacin, and thiamin on nutrient adequacy during the late 1970's in the United States. Our goal was to examine how the fortification of foods with these four nutrients affected the distribution of nutrient intakes of the population in each age-gender group. Furthermore, we examined which subpopulations benefited the most from fortification, based on income, race/ethnicity, geographical region, and behavioral characteristics.

Since most of today's public safety concern about food fortification relates to the potential for excess intake of iron and folic acid, we examine not only shifts in the proportion of the population with inadequate nutrient intake levels but also, to a limited extent, examine those consuming higher levels. It is important to look at the issue of excess iron intake because nutritionists are concerned with "possible long-term effects of iron fortification programs on iron-replete individuals, especially adult males" *(4)*.

We would have liked to examine the effects of fortification during the last decade with more recent data sets. However, no data base is available that identifies added nutrients in the food supply after 1980. There are so many foods fortified today in the United States, and the food composition table has grown so rapidly over the years, that this research would not be feasible.

Subjects and Methods

Subjects

The sample used for this analysis consists of all persons surveyed as part of the nationally representative 1977-78 Nationwide Food Consumption Survey (NFCS77). Respondents were drawn from stratified area probability samples of noninstitutionalized U.S. households in the 48 coterminous States. For the NFCS77, four data collection waves were conducted, one in each season of the year, each surveying a different sample of participants *(21)*. The NFCS77 contains information from approximately 15,000 households and from 30,770 individuals in all age-sex groups. For the NFCS77, the individual food intake phase covered the entire year and individual family members' intakes were obtained for 3-day periods. Individual dietary intake data for 3 consecutive days were obtained through a mix of 24-hour recall and 2-day food record. This particular analysis included all nonpregnant persons with 3 days of dietary intake, or 28,030 persons. Results are weighted to provide generalizations to the U.S. population in 1977.

Methods

From the 3 days of dietary information, the average daily totals of thiamin, riboflavin, niacin, and iron were calculated (it was not possible to obtain data for other fortified nutrients). This was referred to as the *total* amount of each nutrient from both natural and fortified sources. Then using a special added-nutrient file developed by Cook and Welsh based on foods consumed in the NFCS77 survey, the average amount of fortified thiamin, riboflavin, niacin, and iron consumed was calculated *(5)*. Representative foods included many grain-based products including breads, cereals, breaded foods, and baked goods. Next, by simply subtracting the fortified amount from the total, the *natural* amount of these nutrients coming from the foods consumed was calculated.

Each individual's nutrient intake from total and natural sources was expressed as a percentage of his or her recommended dietary allowance (RDA) using the 1989 RDA values *(17)*. Adequacy of a particular nutrient was defined as 100 percent of the age/gender-specific RDA. The distribution of the population according to level of adequacy from both sources was computed for the population in general and by various subgroups.

To define subgroups by income level, income was expressed as a percentage of the poverty level and was categorized into <185 percent, 185-350 percent, >350 percent. These cut points correspond to those used to establish program eligibility for several U.S. Department of Agriculture and U.S. Department of Health and Human Service programs. Level of education for persons >18 years of age was defined as a dichotomous variable, using 12 years of completed education as the cut point.

Two variables representative of personal characteristics in adults included the body mass index (BMI wt kg/ht m^2) and report of being on a weight loss diet (n=2464). In order to classify adults into weight status groups, a BMI <19.5, 19.5-24.9, 25-30, and >30 was used to classify women into underweight, normal weight, overweight, and obese groups respectively; and a BMI <20, 20-24.9, 25-30, and >30 was used to classify men into similar weight categories *(12)*. Weight data were based upon respondent recall.

Statistical Methods

In examining the shift of the distribution by age groups, the sample sizes in all but the infant age group were adequate to note statistical differences. However, for this age group and for some of the ethnic subgroups, a chi-square test was used to test for statistical difference in the shift of the distribution. This test does not take into account the design effect based on the survey's intracluster correlations.

In order to estimate the magnitude and direction of the design effect, we used the Kish statistic (DEFF) in STATA (version 4.0 1995). This procedure allows one to estimate the value by which the variances are underestimated. It uses the actual design with knowledge of the primary, secondary, and tertiary sampling points to adjust for design effect. We calculated this statistic for various variables presented in our tables and found that the design effect had very little influence on the standard errors of these results. Therefore, we concluded that the change in standard error was so small that the chi-square results would not be changed.

Table 1. Shift in adequacy (100 percent of the 1989 RDAs) for thiamin, riboflavin, niacin, and iron as a result of food fortification for individuals in the 1977 Nationwide Food Consumption Survey[1]

Age/sex group	Thiamin		Riboflavin		Niacin		Iron	
	Natural	Total[2]	Natural	Total	Natural	Total	Natural	Total
	Percent of the 1989 RDAs							
Infants (months)								
<6 (n=203)	77.1	79.2[3]	79.0	81.5[3]	45.9	60.9	66.9	78.0
6 - 12 (n = 202)	77.2	88.7[3]	90.7	93.5[3]	32.7	64.7	20.5	49.0
Children (years)								
>1 - 4 (n=1219)	31.7	75.8	80.3	91.8	32.9	66.3	4.5	25.2
>4 - 7 (n=1379)	21.3	72.1	63.9	85.1	23.1	62.7	10.4	44.1
>7 - 11 (n=1960)	25.7	82.4	74.3	92.6	36.1	77.7	30.2	70.0
Females (years)								
>11 - 18 (n=2266)	17.3	56.2	52.3	70.9	24.5	54.1	4.7	16.2
19 - 51 (n=6618)	12.4	35.4	26.8	42.6	33.7	51.7	5.1	12.4
51+ (n=3914)	17.4	48.1	35.4	55.2	47.1	66.4	34.3	55.3
Males (years)								
>11 - 18 (n=2214)	20.6	66.2	59.6	79.4	30.4	64.8	41.2	73.6
19 - 51 (n=4884)	14.4	43.4	37.6	55.5	47.1	67.9	74.6	87.9
51+ (n=2841)	24.0	60.1	48.1	69.1	62.6	80.1	69.7	84.4

[1]Excludes all pregnant women.
[2]Total includes natural plus foritfied sources of nutrients.
[3]Not significant; p > .01.

Due to multiple comparisons, a more stringent p value was required to define the significance level, $p < .01$. The SAS and STATA statistical software packages were used for all data management and analyses. Except as noted in the tables, all comparisons were statistically significant.

Results

The effect of fortification of foods with thiamin, riboflavin, niacin, and iron on the distribution of the total U.S. population is shown in figure 1, p. 24. For each nutrient, fortification shifted the distribution upwards, with the greatest effect seen for thiamin. If only the nutrients available from naturally occurring sources were considered, the median intake for the entire population (50^{th} percentile) ranged from 70 to 98 percent of the RDA for each nutrient. When the nutrients contributed by food fortification were added to those of natural sources, the median intake shifted to 101 to 123 percent of the RDA.

Shifts in adequacy for each age category and by gender for persons older than 11 years of age are shown in table 1. In this table, the distribution of dietary intake is presented as a proportion of the RDA for all natural sources and then the total, which includes fortified nutrients. Fortification had the greatest effect on infants for niacin and iron, with a greater benefit seen among the older infants. This may be correlated with the introduction of solids at 4-6 months of age, which primarily includes soft grains and ready-to-eat cereals as finger foods. Iron-fortified formulas were introduced into the market after 1977.

Figure 1. Shift in the distribution of percentage of Recommended Dietary Allowances as a result of food fortification among individuals in the 1977 Nationwide Food Consumption Survey (n=28,030)

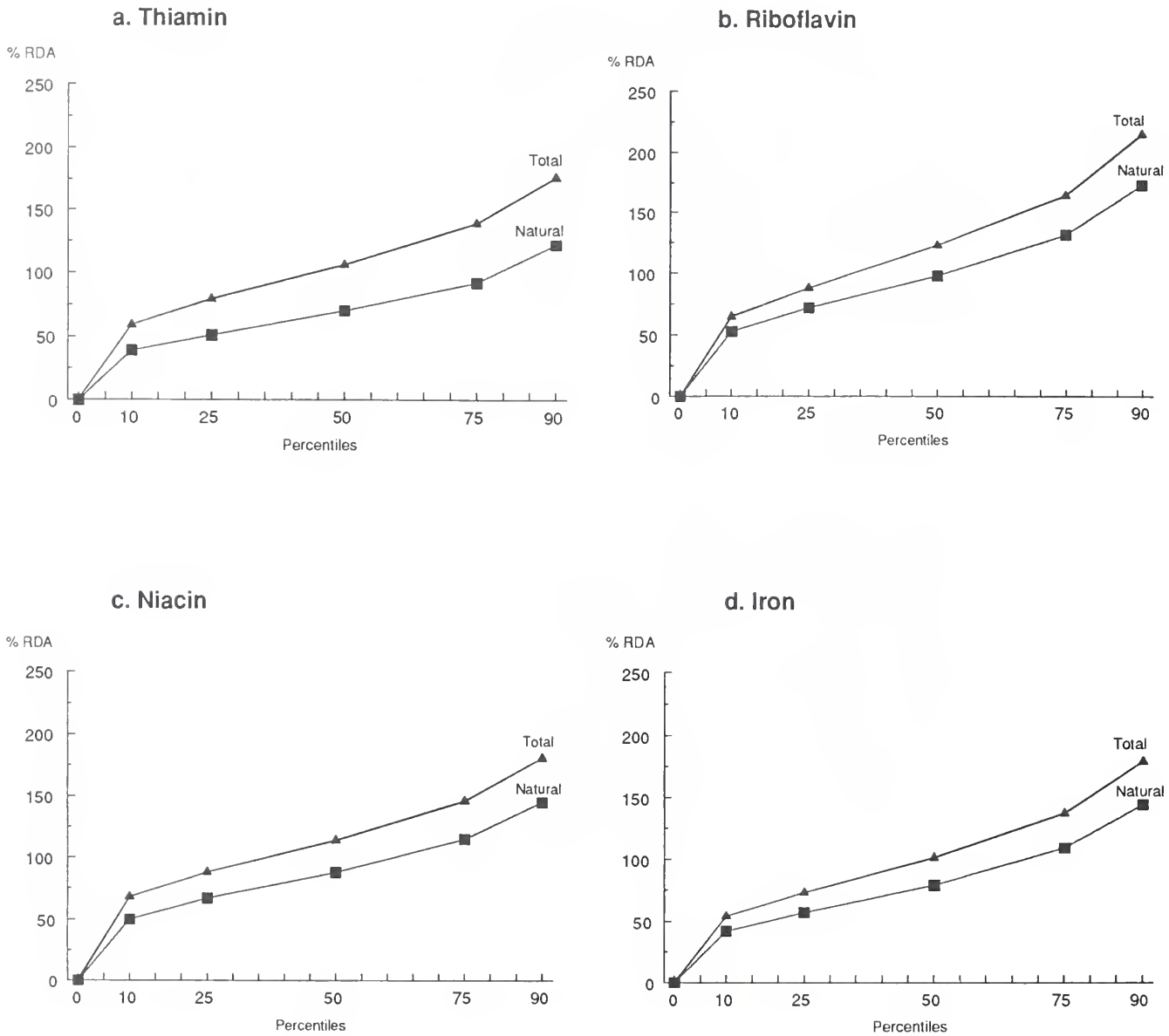
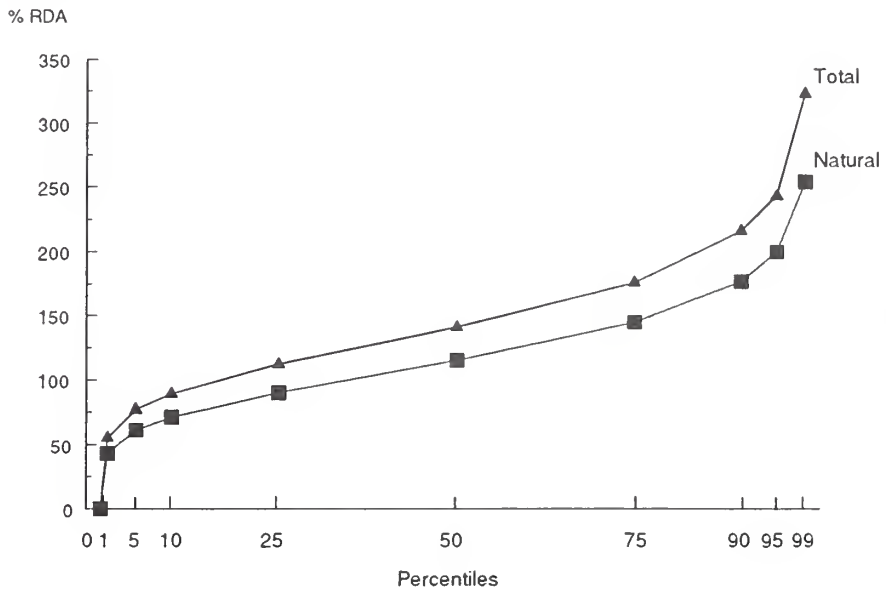


Figure 2. Shift in the distribution of the percentage of Recommended Dietary Allowances for iron among adult males ages 19+ as a result of food fortification, 1977 Nationwide Food Consumption Survey (n= 9,939)



White infants benefited the most from fortification in general but especially with niacin and iron...

Children, in general, benefited from fortification of all four nutrients with 7- to 11-year-olds obtaining the greatest benefit. Males and females over the age of 11 benefited equally from riboflavin and niacin fortification. Adult males benefited more from thiamin fortification than did adult females.

Iron fortification had a major effect on the distribution for children, females over 51, and males of all ages. Females between the ages of 11 and 51 had the lowest percentage of individuals with adequate iron and the least amount of benefit from fortification. Approximately 70 percent of adult men already had adequate levels (100 percent RDA) and 5 percent had above adequate levels (200 percent of the RDA) of iron from natural sources (table 1 and fig. 2). With iron fortification, these percentages went up to 85 percent with adequate levels and 14.5 percent with above adequate levels.

Examination of the effect of fortification for the population in general by income, geographical region, and level of education for adults only revealed that everyone benefited by a similar magnitude. In contrast, examination of the effect by race/ethnicity according to each age group revealed interesting differential results for each nutrient (table 2, p. 26). White infants benefited the most from fortification in general but especially with niacin and iron, while Hispanic children benefited the least from fortification of these two nutrients. Children (1 year and older) of all ethnic groups benefited the same from iron fortification. There

Table 2. Shift in adequacy (100 percent of the 1989 RDAs) for thiamin, riboflavin, niacin, and iron as a result of fortification for individuals in the 1977 Nationwide Food Consumption Survey, by ethnicity and age groups

Ethnic/age group	Thiamin		Riboflavin		Niacin		Iron	
	Natural	Total[1]	Natural	Total	Natural	Total	Natural	Total
	Percent of the 1989 RDAs							
White								
Infants (n=300)	73.3	81.2[2]	80.7	84.3[2]	33.8	61.5	39.7	62.4
Children (n=3410)	24.4	77.4	73.6	91.1	29.4	69.6	16.2	49.9
Females (years)								
11 - 18 (n=1725)	14.7	53.7	53.2	71.3	21.4	52.0	3.2	13.2
19 - 51 (n=5269)	10.7	32.3	27.0	42.7	32.5	50.7	4.0	10.1
51+ (n=3384)	16.5	47.5	35.5	55.9	47.1	66.7	33.7	54.7
Males (years)								
11 - 18 (n=1717)	20.8	68.2	63.9	82.7	29.8	65.3	41.3	74.7
19 - 51 (n=4102)	13.5	42.5	38.5	56.9	47.6	68.5	74.7	88.2
51+ (n=2484)	23.8	60.9	48.6	70.9	63.3	81.3	70.9	85.8
Black								
Infants (n=54)	88.8	92.4[2]	97.7	97.7[2]	62.5	75.2[2]	57.5	70.1[2]
Children (n=673)	29.5	78.5	65.1	85.6	35.4	72.8	19.0	47.6
Females (years)								
11 - 18 (n=348)	23.7	63.0	45.4	68.5	34.2	59.7	8.5	23.9
19 - 51 (n=814)	16.1	43.6	22.4	38.4	36.2	51.7	7.4	17.0
51+ (n=414)	20.7	50.4	33.1	49.3	43.2	61.9	34.9	54.4
Males (years)								
11 - 18 (n=332)	17.2	56.3	39.4	65.4	28.6	60.7	35.5	65.3
19 - 51 (n=473)	15.3	44.8	24.3	39.3	37.7	58.8	68.2	82.8
51+ (n=271)	22.5	48.5	40.5	53.5	52.8	66.8	57.1	71.8
Hispanic								
Infants (n=44)	87.7	91.6[2]	94.9	94.9[2]	46.6	56.3[2]	52.9	64.4[2]
Children (n=401)	33.6	76.2	77.9	90.1[2]	40.8	70.4	24.4	57.7
Females (years)								
11 - 18 (n=164)	30.1	65.6	55.5	70.9	33.5	61.6	13.3	33.4
19 - 51 (n=431)	23.4	53.7	33.5	50.8	43.8	61.9	15.0	30.4
51+ (n=85)	28.5	58.8[2]	38.1	56.1[2]	61.6	78.7[2]	48.4	74.6[2]
Males (years)								
11 - 18 (n=144)	26.8	63.9	53.9	71.7	38.9	66.1	52.5	79.1
19 - 51 (n=235)	28.5	60.6	48.1	62.3	57.6	77.5	87.4	93.0[2]
51+ (n=59)	45.2	82.4	60.2	72.2[2]	78.8	92.7[2]	76.8	89.4[2]

[1]Total includes natural plus fortified sources of nutrients.
[2] Not significant; $p > .01$.

Table 3. Shift in adequacy (100 percent of the 1989 RDAs) for thiamin, riboflavin, niacin, and iron as a result of food fortification for persons age 11+ claiming to be on a weight loss diet (n=2,464) compared with those not on a diet (n=20,275) in the 1977 Nationwide Food Consumption Survey

Group	Thiamin		Riboflavin		Niacin		Iron	
	Natural	Total[1]	Natural	Total	Natural	Total	Natural	Total
	Percent of the 1989 RDAs							
Weight loss	9.7	27.8	26.7	40.6	36.7	49.9	21.3	31.7
Nondieters	17.3	49.8	40.5	59.3	41.8	64.3	38.5	53.7

[1]Total includes natural plus fortified sources of nutrients.

were slight differences for thiamin and niacin, with White children benefiting the most. This same group of children started out lower and also had the largest shift in the distribution for riboflavin.

Riboflavin and niacin fortification benefited women from all age and ethnic groups by a similar magnitude. However, with respect to thiamin, White women age 19-51 started out lower and benefited the least from fortification. In addition, White women 11-51 years of age started out lower for iron than the other ethnic groups and still had the lowest percentage with adequate levels after fortification. In contrast, Hispanic women of all age categories had the highest percentage meeting the RDA for iron from both natural and total sources.

Black males age 51 and over benefited the least from thiamin fortification. With respect to riboflavin, Black male adolescents benefited the most from fortification but still had lower percentages of individuals with adequate levels than the other ethnic groups had. Males from all ethnic groups benefited by similar magnitudes from niacin fortification. Hispanic males of all ages had higher levels of iron adequacy from both natural and total sources than did Black and White males and benefited the least from fortification. Overall, for all ethnic groups, adolescent males benefited more than did older age groups.

Results of shifts in the distribution according to personal characteristics showed that for males age 19-51, underweight males had the smallest benefit with respect to riboflavin fortification, but they also started at a higher percentage of individuals with adequate levels (data not shown). Older men of underweight status benefited the most from fortification of all four nutrients examined when compared with men in other BMI groups. Older men of obese status had the smallest benefit from riboflavin fortification.

In women, there was no differential effect by weight status for ages 19+ for thiamin, iron, and riboflavin fortification. However, with respect to niacin, underweight women age 51 and older benefited more than women in the other weight status groups and obese women age 19-51 benefited the least.

Adults claiming to be on a weight loss diet benefited to a much lesser extent from thiamin and iron fortification than those not claiming to be on a diet (table 3). In addition, the level of adequacy for persons on a weight loss diet was in every case lower than that of persons not claiming to be on a diet.

Discussion

This analysis adds to the small body of research on the impact of fortification. It provides findings related to the effects of fortification on nutrient adequacy. Many sociodemographic factors were studied in an attempt to ascertain where important differentials in the impact of fortification existed during the 1970's.

In respect to income, educational level, and region of residence, the shift in distribution of nutrient intake associated with fortification mirrored that for the general population. The lack of a differential benefit for persons of different income levels is somewhat surprising. This could be a result of similar diets for persons in different socioeconomic groups, but elsewhere we show that different socioeconomic groups had

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different dietary patterns at the time of this survey *(19)*. We believe it is more likely that despite differences in diets across socioeconomic groups, different fortified foods eaten by each group added up to similar amounts of added nutrients. This implies that fortification as a public health intervention may improve the nutritional intake and, theoretically, the health outcome of all Americans.

More significant differences by age and gender categories than across socio-demographic characteristics were seen in this study. Children and adolescent males benefited the most from thiamin, niacin, and iron fortification. It is important to note how fortification during the 1970's influenced the diets of infants and children since they are the groups policymakers are most concerned with when establishing the upper limits of fortification levels. Women of child-bearing ages are of special concern because they have low intakes of iron even with fortification. In 1989, the National Academy of Sciences reduced the recommended level of iron for women, which means that if the RDA applicable in 1977 were used, the percent of women having adequate levels would be much lower.

As noted earlier, a major concern of nutritionists is the effects of iron fortification on iron-replete individuals, especially adult males *(4)*. Termed iron overload, this relates to genetic factors that affect iron balance for persons with hereditary hemochromatosis. Edwards et al. *(8)* have estimated that in the United States, 5 per 1,000 individuals of both sexes have the homozygous genotype for iron overloading though there are subpopulation groups with a higher prevalence *(15)*. The problem of iron overload is particularly of concern for persons consuming very high levels of heme iron, which would come from red meat in the U.S. diets, since the level of absorption of other sources of iron is so much lower and seems not to be associated with iron overload *(2)*.

This study shows that the proportion of adult males who consumed more than 200 percent of the RDA increased from 5 percent to 14.5 percent with iron fortification. Today, since more foods are fortified and the iron enrichment standards for flour and breads have been increased, the percentage of males with above adequate levels is likely to be higher than what is reported here.

Also, this study found a lower nutrient intake level for adults claiming to be on a weight reduction diet. Fortification generally improved the diets among those on weight loss diets to the same extent as among nondieters.

This study focused on the effects of fortification on nutrient adequacy during the 1970's. Enormous changes in food industry fortification practices have occurred since that time. Not only has the range of fortified foods increased, but the number of nutrients added has expanded. Unfortunately, we were unable to examine how the effect of fortification may have changed over time and the subsequent nutritional quality implications. Current USDA nutrient data bases do not routinely identify levels of added nutrients. The data base used for this study was a specially developed file that has not been updated. There is considerable renewed interest in the effects of fortification and the need to systematically consider policies governing fortification. Such policy work would require an updated version of the food composition data utilized for this study.

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Food Security and Hunger Measures: Promising Future for State and Local Household Surveys

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A new questionnaire to measure food insecurity and hunger in the United States was recently included as a supplement to the Bureau of the Census' monthly Current Population Survey. The supplement collects information from households that can be applied to measuring the existence of food insecurity and hunger at the State and local level. The development of the survey instrument, its content, and its relation to State and local research are described.

The National Nutrition Monitoring and Related Research Act of 1990 set forth a 10-year plan of action for the U.S. Departments of Agriculture (USDA) and Health and Human Services (DHHS). The plan calls for the development of a standard measure of food insufficiency or food insecurity[1] and standard methods for their use at the State and local level (Recommendation Number V-C-2.4) *(11)*. The work to accomplish these goals is well under way.

This article describes the development of a new survey measure of food insecurity and hunger that may be applied at the State and local level. The article also examines how the measure can monitor problems in food adequacy, food supply uncertainty, and balancing food spending with other expenses. Use of this measure can highlight differences among areas of the United States in food security status.

The Need for Standardized Measures for State and Local Areas

During the early 1980's, a number of State and local hunger surveys were conducted. The purpose of many of these surveys was to determine the unmet need for food assistance in various communities throughout the Nation. Two back-to-back recessions and a political climate that challenged the wisdom of public spending, especially for antipoverty programs, precipitated the need for these surveys.

[1]Food insecurity has become generally accepted as the term for describing problems of food deprivation that result from poverty.

Although these surveys were well intended, they led to conclusions that lacked a rigorous basis. In some cases, the surveys did not use scientific sampling and survey methods, and their findings could easily be challenged. Most importantly, these surveys lacked a standard measure that could be used to make estimates comparable across localities. They could not answer a simple but most important question: "Was hunger more prevalent in city A than in city B?"

Therefore, two separate but similar research efforts were begun—one at Cornell University's Division of Nutritional Sciences and the other through the Community Childhood Hunger Identification Project. Both of these efforts were systematic and scientific *(10)*. USDA's Food and Consumer Service, in cooperation with other Government agencies and the private sector, used both these efforts as a basis for developing a new survey instrument.

In 1992, the Federal Government began to develop national measures that built on this research of the 1980's *(5)*. A scientific conference on food security measurement and research took place in January 1994 *(10)*. As part of the conference, an expert group reached a consensus on requirements of a questionnaire for collecting data on food insecurity and hunger. Following the conference, the Center for Survey Methods Research, Bureau of the Census conducted an extensive test of a draft questionnaire *(8)*. This testing and additional methods considerations led to the development of the Food Security Supplement to the April 1995 Current Population Survey (CPS).

The CPS is a monthly survey that collects information on employment and unemployment and is conducted by the Bureau of the Census for the Bureau of Labor Statistics. In addition to core questions that are used to determine the employment situation, the survey collects supplementary data in each month of the year. About 55,000 households are included in the CPS, and in April 1995, over 80 percent of households, or about 45,000, responded to the food security supplement. The supplement collected data that measured the national level of food insecurity and hunger. A second food security supplement was administered in September 1996.

USDA's Food and Consumer Service sponsored the survey supplement and contracted with a nationally known private research firm, Abt Associates, to develop methods to interpret the survey data.[2] Data from the supplement were analyzed, and a method was developed to identify response patterns that would indicate household food insecurity and hunger at varying levels of severity. This annual survey is expected to set a standard for use in State and local areas. Thus, recommended field-tested methods will be available for measuring hunger and food insecurity in a consistent and reliable manner in towns, cities, and States across the Nation. The methods applied to the questionnaire, described below, use the most recent techniques for scaling survey questionnaire items.

[2]On this project, Abt Associates worked with experts from Cornell University's Division of Nutritional Sciences; Cheryl A. Wehler and Associates, Inc.; and the Tufts University Center on Hunger, Poverty, and Nutrition Policy.

Definitions Underlying the Instrument

The CPS supplement relied on definitions from a major report prepared for the American Institute of Nutrition by an expert panel convened by the Life Sciences Research Office (LSRO) of the Federation of American Societies for Experimental Biology. This report provided a precise definition of food security and related it to food insecurity, hunger, and malnutrition *(1)*:

> **Food security** was defined as access by all people at all times to enough food for an active, healthy life and includes at a minimum: (a) the ready availability of nutritionally adequate and safe foods, and (b) the assured ability to acquire acceptable foods in socially acceptable ways (e.g., without resorting to emergency food supplies, scavenging, stealing, and other coping strategies).
>
> **Food insecurity** exists whenever the availability of nutritionally adequate and safe foods or the ability to acquire acceptable foods in socially acceptable ways is limited or uncertain.
>
> **Hunger**, in its meaning of the uneasy or painful sensation caused by a lack of food, is in this definition a potential, although not necessary, consequence of food insecurity. Malnutrition is also a potential, although not necessary, consequence of food insecurity.

Conditions Contributing to Hunger Excluded From Survey

Hunger and food insecurity can stem from other sources such as limited personal capacity (illness, infirmity) or limited availability of nutritionally adequate and safe foods in the community at large. Hunger may result from conditions such as Alzheimer's disease or anorexia, but these survey instruments were not intended to capture and measure these conditions.

Similarly, simple physiological hunger—the uneasy or painful sensation caused by lack of food—can result from dieting, fasting, or simply being too involved or too busy to eat. Everyone skips meals on occasion, but that event alone is not food insecurity or poverty-driven hunger. These conditions exist only when meals are skipped because there is not enough money to provide them. Cutting back on meals because of dieting and fasting for health or religious reasons are not public policy concerns and were not intended to be measured.

These definitions indicate a quantifiable and measurable concept of food insecurity. For example, one interesting aspect of food insecurity, as defined here, is that it exists if people are resorting to emergency food supplies; that is, using food banks, food pantries, or soup kitchens to get food. Also, a key aspect of the definition is that hunger can be seen as a narrow condition existing within food insecurity. In this way, hunger represents a severe stage of food insecurity. When food insecurity is identified without evidence of hunger, a less severe stage of food insecurity can be said to exist. For example, the absence of the assured ability to obtain sufficient food is expressed as anxiety about the family's food supply.

For use in the CPS Food Security Supplement, the above definitions were modified so that measurement was limited to food insecurity and hunger that was poverty-linked (see box). The CPS instrument restricts food insecurity and hunger measurement to conditions arising from economic deprivation. Food insecurity exists when people cannot purchase adequate food because they lack money or food stamps. Hunger is as defined above, and in addition, it is a condition of going without food because of not having money, or food stamps, to buy food. Food insecurity and hunger, in this context, are consequences of poverty or near-poverty status. The food security concept is linked with resource requirements, and in this regard, ready availability of nutritionally adequate and safe foods is a function of adequate household resources.[3]

Food insecurity exists when people cannot purchase adequate food because they lack money or food stamps.

[3]The term "resource-constrained hunger" is cumbersome, but the simpler "involuntary hunger" is not strictly accurate. Efforts to manage diminishing resources so as best to meet household needs causes the operative household member(s) at some point to *choose* to forgo eating (i.e., to opt for current hunger) in order to conserve what food there is for other household members (particularly children) or to stretch the use of inadequate food supplies over a longer period. This is a good example of the economic-theoretical concept of rational consumer-choice behavior under severe resource constraint. It also corresponds closely to the Radimer/Cornell concept that "hunger is a managed process" *(7).* In the terminology of these concepts, genuinely voluntary hunger such as dieting or fasting (i.e., nonresource-constrained) may be described as "hunger, *but not* food insecurity."

A limitation of the CPS-based measures is their dependence on household survey data; community-level data and data on the homeless are excluded.[4] Community-level variables have been proposed as indicators of food insecurity, but these may not be easy to interpret. Based on the LSRO definitions, a large number of food banks, food pantries, and soup kitchens relative to population density would indicate potential food insecurity.

On the other hand, a small proportion of these institutions would not necessarily indicate the absence of a food insecurity problem. In fact, it may indicate unmet need. Future surveys at the State and local level could include the homeless if special provisions are made. These provisions would include precise sampling and interviewing methods that would ensure the collection of reliable information.

Finally, measures of nutritional inadequacy are not incorporated with hunger and food insecurity indicators. Although recent research indicates that food inadequacy is related to diet quality, food insecurity and hunger can be measured independently *(3, 6)*.

[4]A National Survey of Homeless Assistance Providers and Clients, conducted by the Bureau of the Census in 1996, will provide some information to assess the food security and hunger status of the homeless.

Development of the CPS Instrument

The questionnaire sections comprise a coordinated set of indicators designed to capture the full range of food insecurity problems. The questions are derived out of substantive, practical, and survey-method considerations. The aim throughout was to develop, as nearly as possible, a state-of-the-art survey instrument for food insecurity, based on available research. Almost all the final items are adapted directly from the existing body of research in hunger measurement. In some cases, questions developed in more specialized or in-depth small sample surveys had to be modified to meet the operational requirements of the more efficient, but respondent burden-sensitive, large-scale CPS—the first vehicle for the new instrument.

Time considerations required a reduction from the complete range of candidate items available from the research literature. The resulting question set, even at 58 items, is more limited than several previous efforts *(6, 12)*. The guiding criterion for selecting questionnaire items was to make the CPS supplement an adequate empirical base from which to derive and construct a valid and reliable measurement scale. This measurement scale spans the entire range of the food-insecurity and hunger phenomenon, as experienced and reported by respondents.

The Center for Survey Research Methods, Bureau of the Census, made recommendations on survey methods that influenced virtually every point of questionnaire design, including questionnaire format, sequencing, skip patterns, and wordings. In some instances, survey methods were in conflict with measurement needs. For example, a time reference period based on the past 12 months is essential for its relevance to cycles of household resource acquisition, program participation, and other key related data, although survey method principles indicate that shorter reference periods would likely achieve greater accuracy of respondent recall.

Content of the Survey Instrument

The instrument[5] is divided into four sections. Section I provides background information and is asked of all CPS households. It surveys food shopping patterns, expenditure levels, and participation in national food assistance programs.[6] Section II contains items on the amount of food eaten in the household and reasons why people don't always have enough to eat.[7]

[5]The Food Security Research Team of the Food and Consumer Service led the development of the Food Security Questionnaire *(2)*. The Bureau of the Census, National Center for Health Statistics, members of a Federal interagency working group on food security, and a number of experts outside the Federal Government made extensive contributions. Any questions on the survey may be directed to Drs. Andrews or Bickel, Food and Consumer Service, USDA, 3101 Park Center Drive, Alexandria, VA 22301, (703) 305-2017.

[6]Higher income respondents were not asked questions on participation in food assistance programs such as Food Stamps and WIC.

[7]Items in Section II that indicate households sometimes or often not having enough to eat, running short of money for food, and running out of food to make a meal without money to get more are used to screen households above the low-income cutoff into Sections III and IV. Households below a low-income cutoff, equal to 1.85 times the poverty level, automatically were asked the questions in Sections III and IV. The September 1996 supplement applied the screener to low-income as well as higher income households.

Food Security Measurement Instrument

Section I

Food shopping patterns

Food expenditures

Food assistance program participation (Asked only in households with income at or below 1.85 times the official poverty level.)

Section II

(Items are used to screen higher income households for Sections III and IV.)

Assess amount and kind of food eaten

Reasons for not enough food

Running out of food or food money

Section III

Ways to cope with less food

Skip or cut meals*

Do not eat for a whole day*

Go hungry because no money to buy food

Section IV

Direct reports on household food supply*

*These items are asked for adults and children in the household.

Sections III and IV contain 41 items that together are used to identify food insecurity and hunger. Items in Sections III and IV are asked only of households at or below a low-income cutoff and households above the cutoff that indicate by their responses in Section II that they may be food insecure.

Section III contains a combination of 35 behavioral and other items that reflect typical stages of food insecurity and hunger within households. These stages have been described as a "managed process" of dealing with food insecurity and hunger *(7)*. The questions reflect ways that households manage food (and resources to buy food) when they are approaching, or have reached, the point of hunger. For example, typical household responses may include borrowing money for food, putting off paying bills to buy food, and seeking emergency food sources. At more severe levels, typical ways of managing imply actual hunger for at least some household members, evidenced as adults cutting back or skipping meals, being hungry but not eating because they can't afford food, and going full days with no food.

Section IV contains six statements that respondents answer by indicating whether the statement has been true for them or not during the past year.[8] These items require respondents to reflect upon the household's food situation and offer their perceptions of the household's food supply. For example, "(I/we) worried that (my/our) food would run out before (I/we) got money to buy more—was that often, sometimes, or never true for you in the last 12 months?" Three of the six items are directed specifically to households with children. For example, "(I/we) relied on only a few kinds of low-cost food to feed (child's name/the children) because (I was/we were) running out of money to buy food—was that often, sometimes, or never true for you in the last 12 months?"

Evaluating Survey Responses

The food security and hunger condition exists as a continuum, from the least severe condition to the most severe *(2, 6)*. The goal is to identify households experiencing one of three states of food insecurity based on their responses to the survey. The least severe condition exists as food insecurity without hunger. This state is mostly anxiety or worry about not having food or running out of food with no money to buy more.

The next condition is hunger. In this state, adults take steps to ration food by cutting or skipping meals, and in some cases, going without meals for a whole day or longer. In the third state, hunger reaches children or, in households with

[8]This particular method is the one recommended in the Cornell work, which has found it to be a more natural way than direct yes/no questions for respondents to get at this range of experience *(6, 7)*.

The goal is to identify households experiencing one of three states of food insecurity based on their responses to the survey.

no children, adults experience prolonged or intense periods of hunger. Children's hunger comes from missing or skipping meals. In adults, severe hunger results from regularly—or frequently—cutting or missing meals. A very severe form of hunger exists if parents go a whole day without eating. It indicates that they are going without eating to feed their children. These conditions indicate an exhaustion of other coping strategies that include resorting to food banks, food pantries, soup kitchens, or borrowing food from friends or relatives.

A very important feature of these indicators is their ability to reveal different patterns of behavior. Although children not eating usually always indicates severe hunger, there are a number of other patterns that indicate less severe levels of food insecurity. The most severe levels of food insecurity may be avoided by use of community resources.

For example, if a household's food stamps run out at the end of the month and they have no available cash or savings, they may be able to go to a food bank or pantry. In this way, the family may be able to obtain enough food for the month and avoid actual hunger. But, since the food was acquired through extraordinary measures rather than normal channels, the family would be considered food insecure; their food supply is contingent on getting emergency food. If the food bank does not have enough for them, or they move to a town with no food bank, or the food bank closes, the family falls into a more severe level of food insecurity, even hunger.

The responses to the survey are related to each other through a statistical technique known as scaling. Specifically, the responses are fit to a factor analytic measurement model for interpretation *(4)*. The model selects those questions that seem to be the most sensitive indicators of household food insecurity and hunger in U.S. households. In general, households receive a score and can be grouped accordingly: experience no hunger or food insecurity, food insecurity without hunger, food insecurity with evidence of adult hunger, or food insecurity with evidence of child hunger and severe adult hunger *(9)*.[9]

Future Research

There are three avenues of research that could extend the work on measuring food security and hunger. The first links hunger and food insecurity measures with nutritional status and health consequences. Such studies can fill the gap in knowledge concerning the effects of improper nutrition in health problems among the poor.

The second research area involves the use of subsets of items to rapidly assess the nutritional status of households. If this was shown to be feasible, the Food Security Measurement instrument could be used by State and local organizations to provide information that could diagnose households in need of nutritional assistance. This research could contribute valuable information about food insecurity and hunger as causes for inadequate nutrition.

[9]Detailed information about the method used to form a measurement scale from the data and the development of that method is forthcoming in a report by Thompson et al. *(9)*.

The third area monitors the effects of welfare reform on hunger and food security levels. As States change their welfare programs, the instrument can monitor the food well-being of those affected and the entire population of cities and towns.

In 1997, the Food and Consumer Service will publish a handbook on measuring food security and hunger. The handbook is intended to assist practitioners who wish to collect food security data in State or local sample surveys. It will provide relevant question sets and technical guidance on interpretation of survey responses, estimating a measurement scale for food insecurity severity levels, statistical testing of data, and reporting of data. Use of the handbook will assist in the accurate collection of data and allow the data to be comparable across States and localities. Future reports may include information that applies directly to local areas.

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Research Brief

Estimating Nutrient Contributions From Lean Beef and Pork in the U.S. Food Supply Series

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The U.S. food supply series is a historical data series, beginning with 1909, that measures the amount of food available for consumption in the United States. Within the U.S. Department of Agriculture (USDA), the Center for Nutrition Policy and Promotion uses data on the amount of food available for consumption from the Economic Research Service together with information on the nutrient composition of foods from the Agricultural Research Service to estimate the nutrients available in several hundred foods in the food supply[1] *(6, 22).*

The food supply series has a number of uses. Food supply estimates are an important component of the National Monitoring and Related Research Program *(20)* because they provide unique and essential information on the amount of food and nutrients available for consumption. Food supply data are invaluable for monitoring the potential of the food supply to meet the nutritional needs of the U.S. population and for examining historical trends and evaluating changes in American diets.

[1]The nutrient estimates are calculated by multiplying the per capita amount of each food by the nutrient composition of that food. The results from all foods are then totaled for each nutrient and presented on a per day basis.

Also, because the food supply series measures food and nutrients over time, changes in technology and marketing practices in food commodities can be observed before and after a specific event.

Since the late 1970's, the red meat industry has undergone a number of technological advances and improved marketing practices that impact directly on the U.S. food supply. These changes are closely related to a change in USDA Yield Grades *(1)*, the red meat industry's reaction to findings and recommendations of the 1986 National Consumer Retail Beef Study *(3)* and 1991 National Beef Quality Audit *(7)*, as well as the red meat industry's response to Federal dietary recommendations to decrease fat and saturated fat in American diets *(19)*.

Specifically, feeding practices, genetic and animal management practices, meat handling, and merchandising practices have been modified to improve production efficiency and to respond to consumer's health concerns about dietary fat. These changes have influenced not only the quantity and quality, but also the variety of lean red meat choices from beef and pork available for consumption in the food supply.

To account for these changes, provide more accurate estimates of consumption, and to reflect the nutrient contributions from these lean red meats in the food supply, the conversion factors used to convert carcass weight to retail weight of beef and pork and to boneless weight for beef have been revised over the series. Specifically, adjustments have been made to both the beef and pork quantity and nutrient databases to reflect these revised factors. Overall, closer trimming of fat and more bone removal have resulted in less of the carcass being available to the retailer and thus available for consumption. Thus, the adjustments made here compensate for quantity overestimates and reflect up-to-date nutrient information.

Methods

Conversion factors to determine the leaner cuts of beef and pork were revised based on information, calculations, and recommendations from several sources *(1, 9, 10, 12, 14, 15, 21)*. Each conversion factor is based on a change in animal husbandry or technology, marketing practices of fat and bone at the packer or retail level, or a combination of these events at specific periods over the series. Since conversion factors implicitly assume that a certain percentage of carcass weight (fat, bone, connective tissue, and shrink) is removed or lost before the product reaches the retail market or the consumer *(8)*, adjustments to old conversion factors were made to account for changes in the amount of fat and bone, especially for boneless cuts removed during processing and distribution.

For beef, Yield Grade *(1)* was a major consideration in the adjustment in animal composition because the lower the Yield Grade, the less fatty the animal carcass *(8)*. Also, current retail practice of fat trim replaces the 1/2-inch trim of the 1970's and 1980's with 1/4-inch trim.

For pork, the conversion factor was adjusted downward to better reflect the changing mix of lean and fat on the carcass and the smaller percentage of carcass available for fat cuts since the late 1960's *(4, 5)*. These revised factors were based on bellies percentage yield

Conversion factors for beef and pork, lean

Beef, lean (years)	Old factor	Revised factor
1970-85	0.674	0.698
1986	0.674	0.690
1987	0.674	0.670
1988-90	0.674	0.667
1991-93	0.674	0.663
1994	0.674	0.661

Pork, lean and fat (selected years)	Lean	Fat[1]	Lean	Fat[2]
1955	0.650	0.280	0.470	0.280
1960	0.650	0.280	0.475	0.280
1965	0.650	0.280	0.480	0.280
1970	0.650	0.280	0.497	0.268
1975	0.650	0.280	0.532	0.238
1980	0.650	0.280	0.567	0.208
1985	0.650	0.280	0.592	0.188
1990	0.650	0.280	0.604	0.156
1994	0.650	0.280	0.624	0.140

[1]For pork (lean and fat), assumes pork, excluding lard is 93 percent carcass to retail yield.
[2]For pork (lean and fat), assumes pork, excluding lard is between 75 and 78 percent carcass to retail yield, depending on selected year.

from bone-in trimmed wholesale cuts and are divided into lean cuts and fat cuts, with fat cuts comprised of bacon and salt pork or fatback in a ratio of 9 to 1. In the U.S. food supply series, the lean and fat primal cuts of the hog are not included in the carcass series but instead are considered as separate cuts. During the processing of primal cuts, the bellies and other fat components are separated from the leaner components of the carcass. Therefore, to account for the nutrient contributions from these components, it is necessary to include fat cuts as a component separate from that of the total retail carcass weight.

Once adjusted, the revised conversion factors were applied to lean beef and pork quantity estimates over the food supply series to recalculate these estimates. To estimate the nutrient contributions from these revised quantities, Primary Data Set (PDS) values, based on level of fat trim and animal composition changes from USDA's National Nutrient Data Bank, were linked to revised quantity estimates. For "beef, lean" the PDS codes 13003 (1/4-inch trim) and 13795 (1/8-inch trim)—beef, composite of trimmed retail cuts, separate lean and fat, raw for all grades—were used for the years 1975 to 1990 and 1991 to the present, respectively *(13,17)*. For "pork, lean," a historical PDS code, 10003 *(16)* was used for the years 1955 through 1990 and an updated PDS code 10003 *(18)* was used for the years 1991 to the present.

For purposes of illustration, quantity estimates and estimated nutrient contributions from "beef, lean" and "pork, lean" were compared graphically prior to (old data) and after adjustments (new data) were made using revised conversion factors for selected years: 1970, 1990, and 1994 (see figure).

Results and Discussion

The revised conversion factors (see table) account for leaner animals and the decreasing level of fat trim at the retail level as sold in the 1970's, 1980's, and 1990's. The revised conversion factors for "beef, lean" prior to 1987 are higher values than previously calculated. This reflects a more accurate estimate of the 1/2-inch trim used by retailers from the 1970's until 1987. Since 1987, emphasis has been placed on even leaner cuts of meat with 1/4- to 1/8-inch fat trim; thus, lower values are seen for more recent years. The revised conversion factors for "pork, lean" more accurately reflect trends toward leaner hogs, closer trimming of fat, and more removal of bone over the last 40 years.

Also, during this period, extreme genetic pressures and improved nutrition and management practices combined to change the composition of the hog *(2)*. This resulted in a hog with longer legs, a longer and shallower body, bulging muscles, and minimal evidence of fatness. Consequently, the proportion of lard in the carcass decreased, and the weight previously associated with the lard portion of the carcass shifted to the retail weight. As shown by the revised conversion factors, since the mid-1980's, pork is much leaner, trimmed more closely, and larger quantities are being retailed boneless with little or no skin.

The revised quantity estimates (see figure) indicate that less portion of edible product is available for consumption. This difference is related to changes in marketing practices—principally, the closer trimming of fat and increased removal of bone. As expected, the nutrient contribution estimates parallel the lower adjusted quantity estimates. Additionally, nutrient contributions for 1990 and 1994 reflect a leaner product and advances in laboratory methodology for detection and measurement of some nutrients.

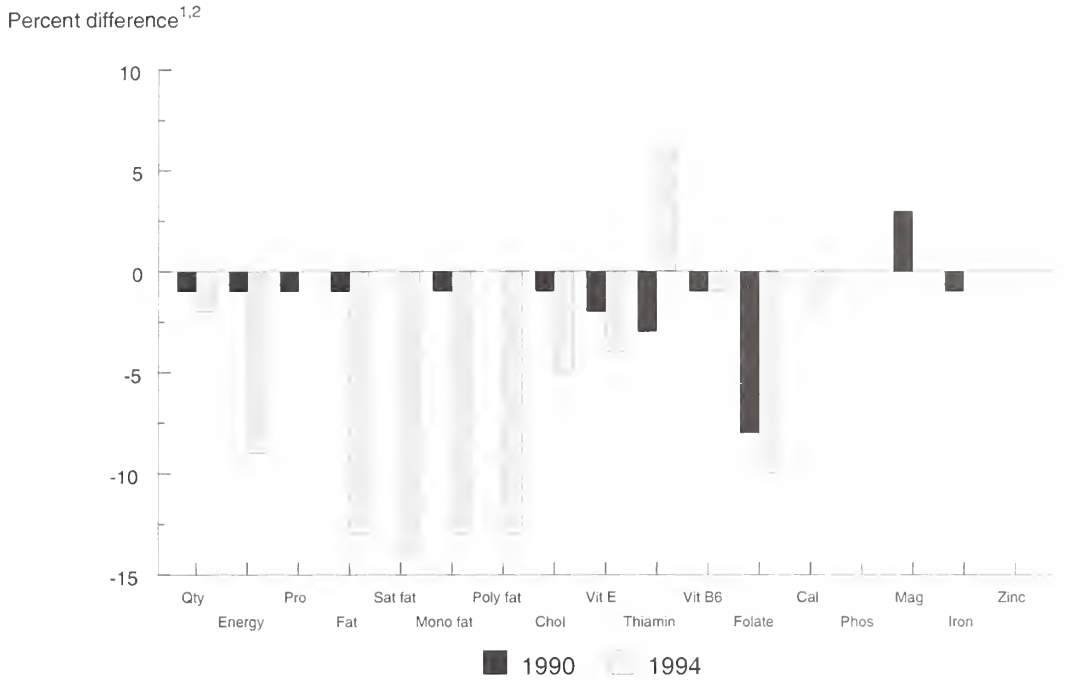
While nutrient estimate percent differences[2] are generally similar in magnitude when compared with quantity estimate percent differences after adjustments with revised conversion factors and updated nutrient data (see figure), several exceptions are observed. In 1970 and 1990, saturated fatty acids and vitamin E are appreciably lower in "pork, lean" and in 1994, appreciably higher in calcium and folate when compared with quantity differences. In 1990 and 1994, differences for "beef, lean" are appreciably lower for folate, and higher for magnesium in 1990 and thiamin in 1994. In 1994, for both red meats, notably less nutrient contributions come from energy, total fat, fatty acids, cholesterol, and vitamin E when compared with quantity differences. Overall, the adjustments made to the quantity and nutrient databases are associated with lower nutrient contributions from beef and pork for many nutrients due to smaller, but leaner quantities of these meats in the food supply.

Application

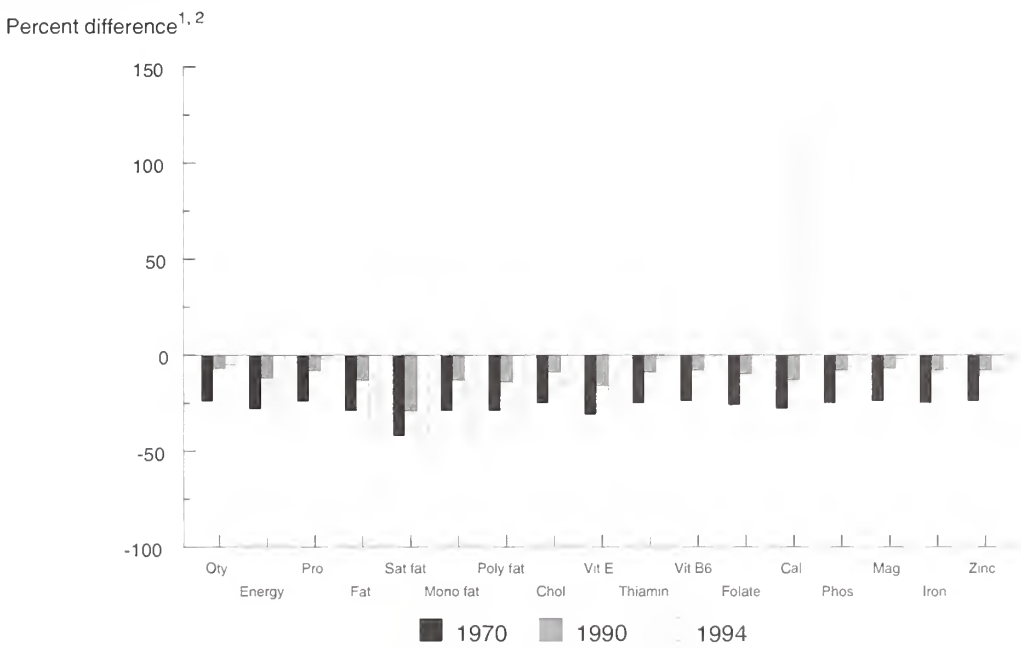
The adjustments made to the food supply beef and pork databases correct for quantity overestimates and reflect up-to-date information over the U.S. food supply series. These adjustments in the revised data are indicative that the technological and marketing changes made by the meat industry since the late 1970's have been particularly responsive to current dietary recommendations for fat, saturated fat, and cholesterol and consumer demand for leaner, healthier products.

[2]Nutrient or quantity estimate percent difference represents the difference of the new estimate (after adjustment) from the old estimate (prior to adjustment) for each year selected.

Beef, lean: Quantity and nutrient estimates, 1990 and 1994



Pork, lean: Quantity and nutrient estimates, 1970, 1990, and 1994



[1]Percent difference represents the difference of the revised estimates from old estimates.
[2]Data points that appear blank represent a zero difference.

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Dynamics of Economic Well-Being: Program Participation, 1991 to 1993

The Survey of Income and Program Participation (SIPP), conducted by the Bureau of the Census, provides a major expansion in the kind and amount of information available to analyze the economic situation of households and persons in the United States. The information supplied by this survey is expected to provide a better understanding of changes in the well-being of the population and the relationship of those changes to the demographic and social characteristics of individuals.

This report uses SIPP data to examine participation in government assistance programs at a point in time, over a 32-month period, and during an average month. Data are from the complete panel file of the 1991 SIPP, covering the period from October 1990 through August 1993. Rates of program participation and amounts of benefits received by subgroups of the population, as well as the distribution of spell durations (length of time receiving benefits) are reported.

Time spent in programs is an important dimension of program participation. Some individuals have longer spells than others, and policy approaches to provide short-term relief are likely to differ from those intended to remedy long-term dependency. SIPP allows longitudinal analysis of program participation, yielding median spell durations as well as distributions of spells by spell length.

Persons are counted as participants in a *major* means-tested assistance program if they are beneficiaries of any of the following programs: Housing assistance, Aid to Families with Dependent Children (AFDC), General Assistance, Supplemental Security Income (SSI), Medicaid, or the Food Stamp Program. In contrast, benefit amounts from major means-tested assistance programs include AFDC, General Assistance, SSI, and food stamp benefits only. For meaningful comparison of benefits, they are valued in constant 1992 dollars. The Food Stamp Program is highlighted, as it is of particular interest to our readers.

The average monthly number of persons who participated in one or more major means-tested assistance programs was 31.7 million in 1991 and 34.0 million in 1992. These totals represented 12.7 and 13.4 percent of the U.S. population in 1991 and 1992, respectively.

Average monthly participation in the Food Stamp Program rose from 7.8 percent of the population in 1991 to 8.2 percent in 1992. The median spell duration for receiving food stamps was 9.6 months during the 1991 panel, compared with a median spell duration of 7.9 months for all major assistance programs and 7.4 months for AFDC or General Assistance.

Household Composition

Persons in female-householder families (no spouse present) had a higher average monthly participation rate in major means-tested assistance programs than did persons in married-couple families or unrelated individuals. Persons in female-householder families were 22 times as likely as persons in married-couple families to participate in AFDC or General Assistance on a long-term basis and were 13 times as likely to

receive food stamps. In 1992, female-householder families had a participation rate of 40.7 percent in one or more major means-tested assistance programs and 29.7 percent in the Food Stamp Program. In contrast, the participation rate in one or more major means-tested assistance programs was 7.5 percent for married-couple families and 13.5 percent for unrelated individuals; the Food Stamp participation rate was 4.2 percent for married-couple families and 5.1 percent for unrelated individuals. Median monthly benefits in 1992 for major means-tested assistance programs were $586 for female-householder families, $341 for married-couple families, and $192 for unrelated individuals.

Female-householder families also had longer periods of receiving benefits from major assistance programs, including food stamps, than did married-couple families or unrelated individuals. During the 1991 panel (1991 and 1992), median spell durations for one or more major means-tested assistance programs were 14.9 months for female-householder families, 7.3 months for married-couple families, and 10.8 months for unrelated individuals. Spell durations for food stamps were 19.3 months for female-householder families, 7.2 months for married-couple families, and 11.3 months for unrelated individuals.

Race and Hispanic Origin

There was a strong correlation between the likelihood of receiving means-tested assistance and race and Hispanic origin (persons of Hispanic origin may be of any race). In 1992, the average monthly participation rate for major assistance programs was 10.3 percent for Whites, 33.0 percent for Blacks, and 26.9 percent for Hispanics. Similarly, 1992 participation rates in the Food Stamp Program were 6.0 percent for Whites, 22.2 percent for Blacks, and 17.7 percent for Hispanics.

Blacks had the longest median spell durations for one or more major means-tested assistance programs during the 1991 panel—12.3 months—compared with 7.6 months for Whites and 7.9 months for Hispanics. Spell durations for food stamp participation followed a similar pattern: 14.9 months for Blacks, 7.9 months for Whites, and 14.2 months for Hispanics. Median monthly family benefits for major means-tested assistance programs in 1992 were $399 for Whites, $484 for Blacks, and $478 for Hispanics.

Age

Children had the highest rates of participation in one or more major means-tested assistance programs, reflecting their higher likelihood of living in poverty. In 1992, average monthly participation rates were 22.5 percent for children under 18 years of age, 9.5 percent for nonelderly adults age 18 to 64 years, and 13.0 percent for elderly adults 65 years of age and over. Food stamp participation rates were 15.9 percent for children under 18 years, 5.6 percent for nonelderly adults, and 3.9 for the elderly.

During the 1991 panel, the median spell duration for food stamps was 12.8 months for the elderly, 11.9 months for children, and 7.6 months for nonelderly adults. Median monthly family benefits from the Food Stamp Program in 1992 were higher for children ($246) than for nonelderly adults ($189) or elderly adults ($47). Benefits from major means-tested assistance programs were also higher for children ($531) than for nonelderly adults ($417) or elderly adults ($198).

Employment and Disability Status

Average monthly participation rates in one or more major means-tested assistance programs varied by employment status of persons age 18 and over. In 1992, the rate for unemployed persons was 22.8 percent, compared with 3.3 percent for those employed full time, 8.4 percent for those employed part time, and 19.8 percent for those out of the labor force. Unemployed persons were also more likely to have ever participated in a major assistance program (29.8 percent) and more likely to have participated all 24 months of 1991 and 1992 (16.7 percent) than were persons in other employment status groups.

The median monthly sum of benefits from major assistance programs in 1992 was highest for persons not in the labor force ($421) and for unemployed persons ($403). Corresponding benefits were $224 for persons employed full time and $260 for persons employed part time. Unemployed persons also received higher food stamp benefits than those in the other employment categories.

The presence of a work disability increased the average monthly participation rate in one or more major means-tested assistance programs of persons age 15 to 69 years. In 1992, 23.6 percent of those with a work disability participated, compared with 7.4 percent of those with no work disability. Although benefits from all major assistance programs were equal for those with and without a work disability, those without a work disability received higher food stamp benefits ($211) than did persons with a work disability ($130).

Source: Shea, M., 1995, *Dynamics of Economic Well-Being: Program Participation, 1991 to 1993*, Current Population Reports, Household Economic Studies, P70-46, U.S. Department of Commerce, Bureau of the Census.

Trends in Out-of-Pocket Spending on Health Care, 1980-92

Throughout the 1980's, the medical component of the Consumer Price Index rose at twice the rate of inflation. Rising prices caused some employers to reduce employer-sponsored insurance coverage, which increased the pressure of medicaid and medicare spending on the Federal budget.

This article examines whether families are having to pay an increasing share of total household expenditures for health insurance, prescription drugs, hospital stays, and visits to the doctor out of their own pockets—and thus, have less money to spend on other goods and services.

Aggregate data from the National Income and Product Accounts (NIPA) and family level data from the Consumer Expenditure Surveys (CE) were used to examine trends in spending on health care. These data show that health care expenditures are consuming an increasingly larger share of total spending in the United States; growth in the medical sector has outpaced all of the aggregate income or output measures in the National Accounts. The share of personal consumption devoted to medical care, which includes all spending by or on behalf of households, rose from 11.9 percent in 1980 to 17.0 percent in 1992, according to NIPA data.

Health care spending has three components: Federal Government spending (largely medicare and medicaid), business spending on employer-provided insurance, and direct spending by individuals and families (out-of-pocket spending, including insurance premiums paid by households). Since direct out-of-pocket spending accounts for only one-third of all health-related spending, most of the growth in health care costs was absorbed through higher budgetary outlays by Government and increased labor costs for businesses. Thus, the large increase in health care costs between 1980 and 1992 has been "hidden" in increased taxes, lower wages, and higher prices for other goods.

Government-provided health care rose from 4.1 percent of consumption in 1980 to 6.6 percent by 1992. Employer-provided health care rose from 3.6 percent of consumption in 1980 to 5.2 percent in 1992. The residual out-of-pocket health care paid for out of household budgets rose from 4.1 percent of consumption in 1980 to 5.2 percent by 1992. Each of the three components grew proportionately between 1980 and 1990, but between 1990 and 1992, Government's share increased rapidly while the out-of-pocket component dipped. This coincides with expansions in the Medicaid program during the 1990-91 recession.

During economic downturns, Government spending on the nonelderly should represent a larger share of total health spending because more people receive public assistance at those times. Government spending on the elderly as a percentage of all health spending grew from 17.2 percent in 1980 to 18.7 percent in 1992, while spending on the nonelderly increased from 17.8 percent to 20.2 percent.

Spending Across Demographic Groups

Aggregate data show that between 1980 and 1992, escalating health care costs had only a modest impact on household budgets, and individual households shifted their spending away from direct-fee-for-service purchases to insurance. The table shows the extent to which these trends persist across demographic groups for household expenditures on (1) health care expenditures as a percentage of total household expenditures, (2) health insurance as a percentage of total household expenditures on health care, (3) hospitals and physicians as a percentage of total household expenditures on health care, (4) prescriptions drugs as a percentage of total household expenditures on health care, and (5) supportive care as a percentage of total household expenditures on health care.

Health Care Expenditures as a Percentage of Total Household Expenditures

Poorer households devote a larger share of their budgets to health care than do households with higher incomes. Rural families spent a higher share of their total expenses for health care than urban families and showed the highest increase over the 1980-92 period. Black families consistently spent a lower budget share on health care than non-Black families spent. Also, single-parent families devoted a smaller proportion of their budgets to health care than did other families. This may reflect the relatively high medicaid enrollment for this population.

Out-of-pocket health care expenditures by households, 1980 and 1992

Characteristic	Health care as a percentage of total expenditures		Health insurance		Hospitals and physicians		Prescription drugs		Supportive care	
	——Expenditures as a percentage of total health care expenditures——									
	1980	1992	1980	1992	1980	1992	1980	1992	1980	1992
All consumer units	4.2	5.0	25.7	36.4	30.1	20.9	10.4	10.8	33.8	31.9
Annual household expenditure level										
<$15,000	5.7	6.4	31.7	36.1	30.2	19.7	11.5	14.6	26.6	29.6
$15,000 - $30,000	5.0	6.1	26.8	39.4	31.3	19.7	10.2	10.9	31.7	30.0
>$30,000	3.3	4.0	21.9	33.8	27.4	22.6	10.0	9.2	40.7	34.4
Region										
Rural	5.1	7.1	28.7	40.1	30.2	16.4	11.8	15.1	29.3	28.4
Urban Northeast	3.9	4.7	22.9	35.1	27.7	22.7	9.8	9.2	39.6	33.0
Urban Midwest	3.8	4.6	27.5	35.5	26.5	21.5	10.4	10.9	35.6	32.1
Urban South	4.7	5.4	26.8	37.2	31.2	23.4	11.0	11.0	31.0	28.4
Urban West	3.7	4.2	21.6	34.3	31.6	19.4	8.3	8.3	38.5	38.0
Race										
Black	3.5	3.5	32.3	46.1	31.1	15.3	11.3	11.0	25.3	27.6
Non-Black	4.3	5.2	25.2	35.8	29.3	21.3	10.3	10.8	35.2	32.1
Family type										
No children	4.4	5.3	26.9	34.7	27.3	19.8	11.1	13.4	34.7	32.1
Single parent	3.1	4.2	26.0	34.9	32.2	22.3	9.2	10.3	32.6	32.5
Two-parent	4.3	5.0	24.6	38.8	31.1	21.9	9.9	8.1	34.4	31.2
Age of head of household										
<25	2.8	2.5	27.0	32.3	36.6	28.7	8.7	9.5	27.7	29.5
25 - 34	3.5	4.1	27.9	40.1	34.0	26.0	8.2	7.7	29.9	26.2
35 - 44	4.1	4.9	22.8	36.3	29.6	20.0	8.6	9.0	39.0	34.7
45 - 54	4.6	5.3	25.6	35.1	28.3	18.4	11.2	12.7	34.9	33.8
55 - 64	5.7	7.4	26.4	35.5	24.9	19.4	13.6	14.2	35.1	30.9

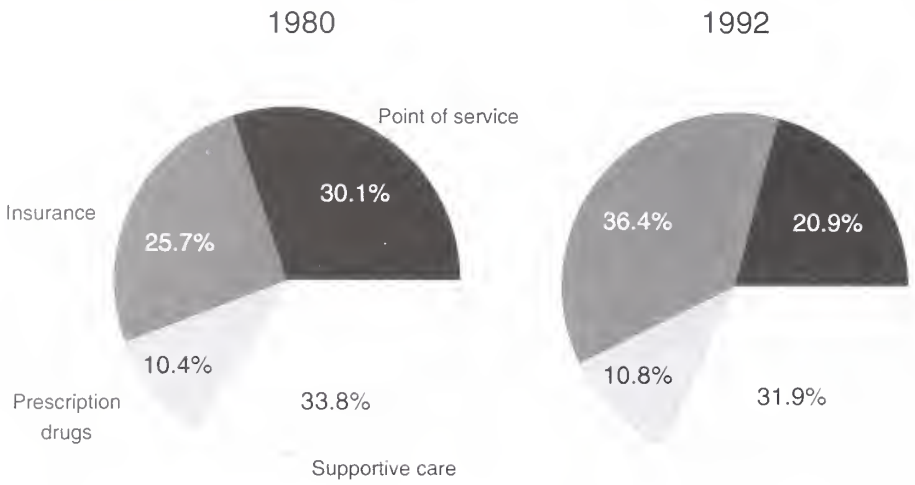
Note: Households with heads ages 65 and older are excluded.

Households headed by individuals under age 25 spent a lower percentage of total expenditures on health care in 1992 than in 1980. In contrast, families headed by individuals ages 55-64 increased the share of their budgets devoted to health care from 5.7 percent to 7.4 percent. Part of the rise for this age group may be attributable to the increasing incidence of early retirement during the 1980's.

Composition of Out-of-Pocket Health Care Spending

The figure shows how the composition of out-of-pocket health care spending changed between 1980 and 1992.

Composition of out-of-pocket health care spending, 1980 and 1992



Source: Urban Institute tabulations, using the Consumer Expenditure Survey.

Although the budget shares for prescription drugs and supportive care (e.g., dentists, opticians) remained fairly stable over the 12-year interval, the share of household health-care dollars going toward point-of-service (hospitals and physicians) expenses fell by 9.2 percentage points. Over the same period, spending on insurance increased by 10.7 percentage points.

Among all demographic groups, **health insurance** occupied a greater share of the household health care budget in 1992 (36.4 percent) than in 1980 (25.7 percent). Spending in lower income households and in those with a household head under age 25 increased at a slower rate than in other households.

Point-of-service payments to physicians and hospitals accounted for a smaller share of the household health care budget in 1992 (20.9 percent) than in 1980 (30.1 percent) among all demographic groups. Households whose share had decreased fastest were rural, Black, or those with a householder age 55-64.

Although the percentage of the household health-care dollar attributed to **prescription drugs** changed very little between 1980 and 1992, families with total spending less than $15,000 a year or living in rural areas spent a higher percentage in 1992 and had increased their share more than had other families.

The share of out-of-pocket spending devoted to **supportive care** declined slightly between 1980 and 1992. Spending shares declined the most among households in the urban Northeast, and those with total spending over $30,000 annually.

Summary

To summarize, spending for health care and health insurance by nonelderly households in the CE grew from a 4.2-percent share in 1980 to a 5.0-percent share of total household expenditures in 1992. The data also show that the modest increase in out-of-pocket spending between 1980 and 1992 held across income, region, race, family composition, and age groups. Virtually all of this increase in out-of-pocket spending was accounted for by increased payments for insurance. The share of health budgets attributed to insurance premiums is pervasive across groups; consumers reacted to rising health care prices by purchasing "more" insurance.

A comparison of out-of-pocket spending by type of insurance coverage shows that the uninsured spend a much smaller fraction of their total budgets on health care than the privately insured because they spend no money on insurance. Overall, households with private coverage devoted more than twice as much of their total budgets to health care as the uninsured.

The significant growth in medical spending has been, in large part, paid for by employers and government, and consumers may not be associating the falling wages and rising taxes needed to cover those outlays with rising health care prices. However, similarities in health-care budget composition across groups in the population suggest that the impact on other consumer goods and services was fairly uniform.

Source: Acs, G. and Sabelhaus, J., 1995, Trends in out-of-pocket spending on health care, 1980-92, *Monthly Labor Review* 118*(12)*:35-45.

Employee Participation in Savings and Thrift Plans, 1993

Household economic well-being is dependent on both income and net worth. Net worth, which is defined as assets less liabilities, measures a household's financial position at a given point in time. Active saving (not consuming all of one's income) increases net worth. Examples of active savings include investing in financial assets, such as savings accounts, stock, bonds, and mutual funds; acquiring real property; and investing in a business. Passive savings is an additional factor that contributes to household net worth. Examples of passive savings include an increase in the market value of a home or of stock holdings over time or the receipt of an inheritance.

While income has been found to have a positive effect on active saving and change in net worth, pension coverage also appears to be important. Research using data from the Panel Study of Income Dynamics found that the number of company pensions reported by heads of households and their spouses was positively associated with active saving and increase in net worth.

Data from the Federal Reserve Board's Survey of Consumer Finances showed that from 1989 to 1992, mean family net worth (in 1992 dollars) rose 11.7 percent (from $197,200 to $220,300), whereas median family net worth remained about the same (about $52,000). The composition of assets held by families also changed during the 1989-92 period. The proportion of families owning retirement accounts, including individual retirement accounts (IRA's), Keogh accounts, and employer-sponsored defined contribution plans, increased from 35.4 to 39.3 percent. The median value of these accounts (in 1992 dollars) increased by 33.9 percent, from $11,200 to $15,000.

These changes reflect, in part, a shift in employer-provided plans from traditional defined benefit plans to defined contribution plans. The proportion of families having defined contribution plans rose from 26.5 percent to 30.7 percent, while that having traditional defined benefit plans declined from 48.8 to 45.1 percent.

The trend toward defined contribution plans accelerated during the mid-1980's. The shift can now be characterized as one from both defined benefit and non-401(k) defined contribution plans to 401(k) plans. In 1985, only 26 percent of full-time workers in medium and large private establishments participated in 401(k) plans. By 1993, 42 percent of full-time workers did so.

Savings and Thrift Plans

Savings and thrift plans are the most common type of defined contribution plans. Data from the 1993 Bureau of Labor Statistics' Employee Benefits Survey show that 29 percent of full-time employees in medium and large private establishments participated in a savings and thrift plan with an employer matching contribution. Ninety-nine percent of the savings and thrift plan participants were in 401(k) plans, where employee contributions are made with pretax dollars.[1]

All savings and thrift plans require a basic employee contribution, which may be matched by the employer. However, not all employers make matching contributions. Data show that 26 percent of full-time employees who participated in savings and thrift plans did not receive a matching contribution from their employer. Many plans allow an additional contribution by the employee in excess of the maximum amount matched by the employer; this is called a voluntary employee contribution.

In 1996, the maximum amount an employee can contribute to a savings and thrift plan on a pretax basis is $9,500. The total amount that can be credited to the employee's savings and thrift plan in any given year is also limited to 25 percent of the employee's pay or $30,000, whichever is smaller. Employee pretax and posttax contributions are included in the total as are employer matching contributions and forfeitures of the nonvested benefits of participants who incur a break in service. An employer can use forfeitures to make up part of the guaranteed matching contribution or may allocate them among participants' accounts in addition to matching the employee's contribution.

[1]The employee's taxable income is reduced by the amount of the contribution. However, taxes are deferred, not eliminated—when the employee starts withdrawing funds from the plan, taxes must be paid on the pretax contributions, any employer matching contributions, and any earnings on these contributions.

Vesting[2]

The Employee Retirement Income Security Act of 1974 requires pension plans to adopt a vesting schedule that meets one of the following standards: 5-year cliff vesting, in which participants become 100 percent vested after completing 5 years of service; and graduated (graded) vesting, in which the employee is 20 percent vested after 3 years of service and 20 percent vested for each subsequent year of service. Full vesting is thus reached after 7 years of service. These rules apply to employer contributions to a single-employer pension plan; employee contributions and earnings on them are immediately vested. Of 1993 savings and thrift plan participants, 33 percent were covered by plans with graduated vesting, 29 percent were in plans with cliff vesting—with most vested after 5 years, and 34 percent were vested upon joining their plans.

Investment of Contributions

The majority of savings and thrift plans offer a selection of investment choices. Some of the offerings are company stock, government securities, mutual funds (stock, bond, money market), and guaranteed investment contracts issued by insurance companies. Participants can usually choose investments for their own contribution; less often they can choose how the employer's contribution will be allocated. In 1993, only 56 percent of savings and thrift plan participants could decide where their employer's contributions would be invested, compared with 86 percent who could decide where to invest their own contributions.

[2]The conveying to an employee of the inalienable right to share in a pension fund especially in the event of termination of employment prior to the normal retirement age.

Withdrawals and Loans

Many savings or thrift plan participants are allowed to withdraw some or all of their employer's contributions prior to payout at retirement for reasons such as disability or termination of employment. However, many preretirement withdrawals are both taxable and subject to a 10-percent early withdrawal penalty. In 1993, 29 percent of savings and thrift plan participants were able to withdraw employer's contributions for any reason, and 18 percent could make withdrawals only for hardship reasons, such as medical or educational expenses.

Employees may be able to borrow from their savings and thrift plans. This option has become increasingly popular—available to only 20 percent of participants in 1985 but 45 percent in 1993.

Employee Participation

Provisions of a particular plan such as the employer's matching rate, the number of investment choices, and the method of vesting may affect employee participation. In addition, workers who understand the need to save for retirement and the risk-return tradeoff among investment choices may be more apt than others to participate.

Data from the 1993 Employee Benefits Survey of Medium and Large Private Establishments were used to examine the relationship between selected savings and thrift plan provisions and employee participation in such plans. The sample consisted of employees in savings and thrift plans allowing pretax contributions that were also matched by the employer.

The participation rates of employees in the study sample were compared with those of employees in plans without any employer matching contributions (see table). Employees who were offered a plan with an employer matching contribution were much more likely to participate (80 percent vs. 51 percent, respectively for all employees). Professional employees were more likely than other employees to participate in employer matching plans, whereas clerical workers were more likely than other workers to participate in plans without employer matching contributions. The overall participation rate for all plans was 69 percent.

Although some plans vary the amount of the employer matching contribution, those based on a fixed percentage of employee contributions are the most common. Highest participation rates were generally in plans with an effective match of more than 2 percent of the employee's salary. Therefore, the fact that there is an employer contribution, not the size of the contribution, appears to be a strong inducement to participation. Previous research on 401(k) plans supports this conclusion.

Participation rates in plans that prohibited withdrawal of the employer's contribution were similar to those in plans that allowed such withdrawals, for the sample as a whole. Whether or not vesting occurred immediately did not seem to have an effect on employee participation. Plans with loan provisions had slightly lower participation rates than plans without loan provisions. For the sample as a whole, participation rates were similar for plans in which an employee could direct his or her contribution and for plans in which an employee had no control over where the contribution was to be invested.

Employee participation in savings and thrift plans, by presence or absence of employer matching contribution, medium and large private establishments, 1993

Plan	All employees	Professional, technical, and related employees	Clerical and sales employees	Blue-collar and service employees
		Percent		
All plans	69	73	75	62
Employer matching contribution	80	83	81	77
No employer matching contribution	51	56	59	44

Foster, A.C., 1996, Employee participation in savings and thrift plans, 1993, Monthly Labor Review 119(3):17-22.

Participation rates were also similar regardless of whether the employee could direct the employer's contribution. The only relationship that was found between the number of investment choices and participation in a given plan showed that, with one exception, the lowest rates tended to be in plans that allowed five or more choices.

These findings indicate that other factors may influence the decision to participate. For instance, employee participation in 401(k) plans has been found to increase with income level. This may explain the higher participation rates among professional workers who tend to have higher salaries than the other two groups. However, although blue-collar and service workers typically have higher pay levels than clerical and sales workers, their participation rates were lower. Therefore, increased income levels do not always mean increased participation rates. Other factors, such as job tenure, age, and education, have been found to have a positive influence on participation in 401(k) plans, even after accounting for income and other factors.

More research needs to be done on the factors—particularly income, age, education, and job tenure—that influence participation in savings and thrift and other 401(k) plans. It is possible that various combinations of plan provisions would produce different results. Understanding worker preferences for certain characteristics of savings and thrift and other 401(k) plans may help employers design plans that encourage increased employee participation.

Source: Foster, A.C., 1996, Employee participation in savings and thrift plans, 1993, *Monthly Labor Review* 119*(3)*:17-22.

Nutrients in the U.S. Food Supply

The type and amounts of nutrients available in the U.S. food supply are affected by changes in food variety, food production and technology, consumer preferences, and Federal standards for enrichment. USDA's Center for Nutrition Policy and Promotion estimates the nutrients available in the food supply using data on the amount of food available for consumption (from USDA's Economic Research Service) and the nutrient composition of foods (from USDA's Agricultural Research Service). Since these estimates measure nutrient supplies available for human consumption—without accounting for losses during processing, marketing, or home use—they do not reflect what Americans actually ingest. This article compares nutrients available in the 1990 food supply with those in the 1970 food supply.

All but two nutrients (vitamins A and B12) in the food supply increased between 1970 and 1990. Available calories increased from 3,300 calories per day in 1970 to 3,700 in 1990. Each of the energy-yielding nutrients—fat, carbohydrates, and protein—increased. Carbohydrates showed the biggest gain, from 383 grams per capita per day in 1970 to 452 grams in 1990. This increase reflected greater consumption of corn-syrup sweeteners and grain products, particularly wheat, corn, and rice.

Protein increased from 99 grams per capita per day in 1970 to 105 grams in 1990; poultry, grain products, cheeses, and lowfat milk were consumed in greater amounts. Fat increased from 159 grams per capita per day to 165 grams during this period. Animal products contributed 63 percent of fat in 1970 and 52 percent in 1990. The increased proportion of fat from vegetable sources in 1990 indicated greater use of vegetable oils and shortening.

Cholesterol, which is found only in animal products, declined from 490 milligrams per person per day in 1970 to 410 in 1990—a 16-percent drop. Lower consumption of eggs, red meat, and fluid whole milk was responsible for this decline.

Available quantities of thiamin, niacin, folate, and vitamin E rose between 1970 and 1990. Federal enrichment standards increased the amounts of thiamin and niacin added to flour, higher grain consumption increased folate levels, and greater use of vegetable oils increased vitamin E. Values for riboflavin, vitamin C, and vitamin B6 stayed about the same during this period, whereas those for vitamin A dropped 5 percent and vitamin B12, 16 percent. These two decreases can be accounted for by lower consumption of red meat (particularly organ meat) and eggs. Although values for vitamins A and B12 were lower than earlier levels, they still exceeded the recommended allowances for a healthful diet.

The amount of most minerals available in the food supply also rose between 1970 and 1990. Quantities of calcium, phosphorus, magnesium, iron, and potassium increased, although the amount of copper and zinc stayed about the same.

Available calcium rose from 870 milligrams per capita per day in 1970 to 920 in 1990. Dairy products still contribute three-fourths of the calcium in the food supply, although the specific dairy products supplying calcium shifted during the period. Whole milk's share declined from 37 percent to 15 percent; this decline was offset by an increase in lowfat milk (from 9 percent to 22 percent) and cheese (from 12 percent to 23 percent) consumption.

Nearly all foods contain phosphorus. Available phosphorus increased from 1,470 milligrams per capita per day in 1970 to 1,600 milligrams in 1990. The major sources of phosphorus are dairy products; meat, poultry, and fish; and grain products.

Magnesium in the food supply increased from 320 to 350 milligrams per capita per day between 1970 and 1990. Grain products have replaced the dairy group as the major source of magnesium. Although Americans do not experience magnesium deficiencies caused by an inadequate diet, certain diseases may deplete magnesium in some people.

Potassium levels in the food supply increased from 3,510 milligrams per capita per day in 1970 to 3,540 in 1990. Greater consumption of grain products and noncitrus fruits raised the level of potassium enough to offset lower amounts from decreased consumption of fluid milk, red meat, and eggs. The National Academy of Sciences has recommended increasing fruit and vegetable consumption in order to increase potassium intakes following reports of its beneficial effects on hypertension and a protective effect against vascular damage and stroke.

Iron deficiency anemia is the most common nutritional deficiency among Americans. Fortunately, iron in the food supply increased from 15.5 milligrams per capita per day in 1970 to 19.3 in 1990. Revised Federal enrichment standards that required increased

amounts of iron to be added to flour, together with higher grain consumption, were responsible for the 25-percent increase. Grains' share of iron in the food supply rose from 35 percent to 49 percent during this period, whereas the contribution from both the meat, poultry, and fish group (26 percent in 1970 vs. 19 percent in 1990) and the vegetable group (14 percent in 1970 vs. 11 percent in 1990) declined.

The level of copper in the food supply did not vary greatly during this period, although the relative contributions of some food groups changed. In 1970, the three main sources of copper were vegetables; meat, poultry, and fish; and grains. By 1990, the leading sources of copper were grain products; vegetables; and legumes, nuts, and soy.

The amount of zinc in the food supply was about the same in 1990 as in 1970, and its sources have remained stable. The dominant sources of zinc in both 1970 and 1990 were animal products, dairy products, and grains.

To meet the nutritional needs of the U.S. population, nutrient levels in the food supply must exceed the recommended allowances because estimates do not account for losses from trimming, cooking, waste, and spoilage. Also, since per capita values are calculated as averages, they do not account for the higher nutritional needs of some people. In the future, Americans can anticipate continued change in food and nutrient availability as food producers and manufacturers respond to changing food preferences, new Federal regulations, and new technologies.

Source: Zizza, C. and Gerrior, S., 1995, The U.S. food supply provides more of most nutrients, *FoodReview* 18*(1)*:40-45.

Would you like to publish in *Family Economics and Nutrition Review?*

Family Economics and Nutrition Review will consider for publication articles concerning economic and nutritional issues related to the health and well-being of families. We are especially interested in studies about U.S. population groups at risk—from either an economic or nutritional perspective. Research may be based on primary or secondary data as long as it is national or regional in scope or of national policy interest, and articles may use descriptive or econometric techniques.

With this issue of *Family Economics and Nutrition Review*, we begin a new feature that we call Research Briefs. We define Research Briefs as short research articles. In general, our Guidelines for Authors apply (see back inside cover)—with the following exceptions:

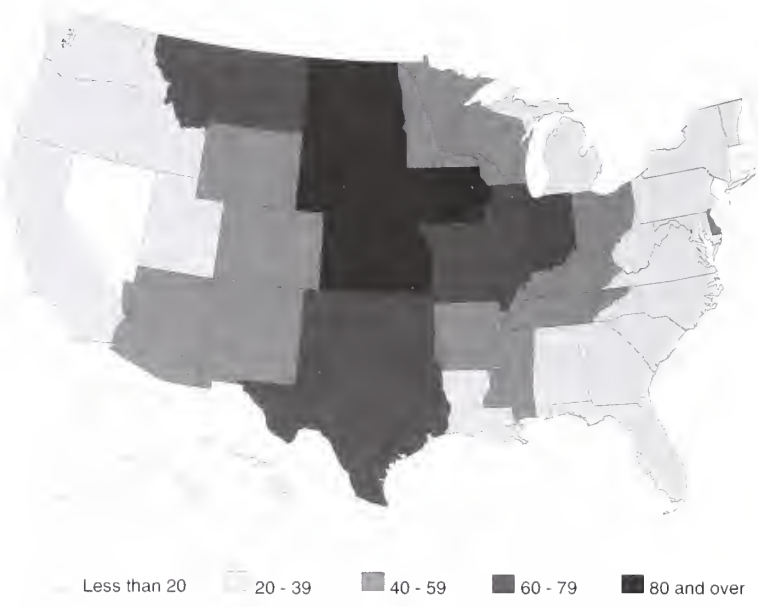
#4—No abstract is required.
#5—Text, references, tables, and figures should not exceed 10 pages.

We invite submission of Research Briefs; manuscripts may contain findings previously presented at poster sessions if not published in proceedings (except for abstract).

Manuscripts may be mailed to: Joan C. Courtless, Editor, *Family Economics and Nutrition Review*, Center for Nutrition Policy and Promotion. See guidelines on back inside cover for complete address.

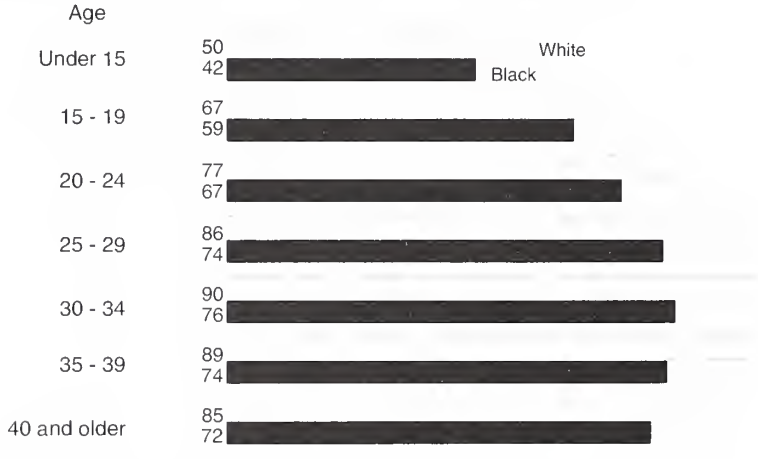
Charts From Federal Data Sources

Percentage of land in farms,[1] 1995



[1]A farm is any establishment from which $1,000 or more of agricultural products were sold or would normally be sold during the year.
Source: U.S. Department of Agriculture, National Agricultural Statistics Service, 1995-96, Agricultural Statistics 1995-96.

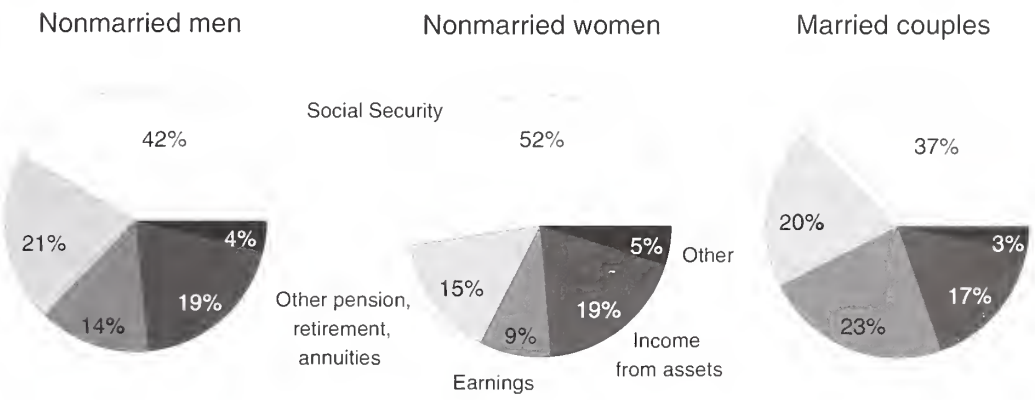
Percentage of U.S. mothers beginning prenatal care in the first trimester, by age and race of mother, 1994



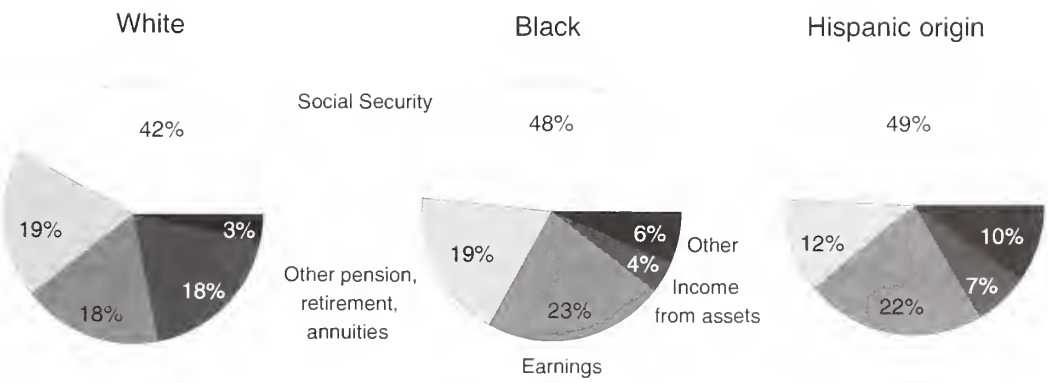
Source: U.S. Department of Health and Human Services, National Center for Health Statistics, 1996, Monthly Vital Statistics Report 44(11):65 Supplement.

Percentage distribution of money income for consumer units 65 years and older

By sex and marital status



By race and ethnic origin



Source: Grad, S., 1996, Income of the Population 55 or Older, 1994, Social Security Administration, SSA Publications No. 13-11871.

Recent Legislation Affecting Families

Public Law 104-120 (enacted March 28, 1996)—the Housing Opportunity Program Extension Act of 1996 extends several Federal housing programs for 1 or 2 years and provides for the establishment of public housing projects for senior citizens and/or disabled individuals. The law states that an individual or family may be evicted if alcohol consumption or drug use threaten the safety of elderly or disabled persons.

Public Law 104-124 (enacted April 1, 1996)—amends the Federal Food, Drug, and Cosmetic Act to repeal the saccharin notice requirement. The requirement stated that information on the possible health effects of saccharin use must be prominently posted in retail establishments that sell food products containing saccharin.

Public Law 104-145 (enacted May 17, 1996)—Megan's Law amends the Violent Crime Control and Law Enforcement Act of 1994 to require the release of relevant information to the local community, to the extent permitted by State law, to protect the public from child molesters and other sexually violent offenders who have been released from custody.

Public Law 104-146 (enacted May 20, 1996)—The Ryan White Care Act Amendments of 1996 reauthorizes the Ryan White Comprehensive AIDS Resources Emergency Act of 1990 for a 5-year period to ensure that individuals living with HIV and AIDS receive appropriate services. The new law requires mandatory testing of newborns if voluntary HIV testing does not bring about a decline in rate of transmission from mothers.

Public Law 104-149 (enacted May 29, 1996)—the Healthy Meals for Children Act amends the National School Lunch Act to provide greater flexibility to schools to meet the *Dietary Guidelines for Americans* for meals served under the National School Lunch and Breakfast Programs.

The Healthy Meals for Healthy Americans Act of 1994 (P.L. 103-448) addressed concerns raised by the 1993 School Nutrition Dietary Assessment (SNDA) study regarding the levels of fat, sodium, and carbohydrates in meals served under the School Lunch Program. The study found that many of these meals were inconsistent with the goals of the *Dietary Guidelines for Americans*. In response, the law required school meals to conform to the *Dietary Guidelines for Americans* no later than the first day of the 1996-97 school year. The law permitted schools to use nutrient standard menu planning (NuMenus), assisted nutrient standard menu planning (Assisted NuMenus), or food-based menu systems to meet the Guidelines. Schools that wished to comply with the Guidelines by using another nutritionally sound approach, such as their existing food-based menu system or their own meal pattern revisions, were required to get a waiver from the State. If they used the Assisted NuMenus option, they were required to provide documentation that supported the claim that their meal pattern met the Guidelines.

Schools throughout the Nation were concerned about the implementation of the regulations. Changes to the food-based menu system had the potential of adding 10 to 17 cents to the cost of school meals. The increased cost was a result of the change in the food-based menu system that required schools to add additional servings of grains, bread, and fruits and vegetables. Schools currently meeting the Dietary Guidelines under the previous food-based menu plan would have to enact such changes. The alternative would be to use the nutrient standard menu plan (NuMenus). This would require schools to make a significant investment in computer hardware and require extensive training and technical assistance to implement the new software and procedures associated with this plan. Numerous schools wished to use the food-based menu system used prior to the enactment of the Healthy Meals for Healthy American Act when attempting to meet the Dietary Guidelines.

The new law will continue the Federal commitment that school meals meet the standards of the *Dietary Guidelines for Americans* but will lift unnecessary regulatory requirements on how schools implement the Guidelines. Schools making good faith efforts to improve their meal services should not be limited to the meal planning choices. The intent of the law is to permit schools to use any "reasonable approach" within the statutory guidelines to meet the Dietary Guidelines and to give schools the flexibility to provide meals that students will eat.

Research and Evaluation Activities in USDA

From the Center for Nutrition Policy and Promotion

The Center for Nutrition Policy and Promotion (CNPP) announces three publications now available to the public on the Internet: *Expenditures on Children by Families, 1995 Annual Report; Using the Food Guide Pyramid: A Resource for Nutrition Educators; and Cost of Food at Home at Four Cost Levels.*

Expenditures on Children by Families

Secretary of Agriculture Glickman released *Expenditures on Children by Families, 1995 Annual Report* on May 31, 1996. This technical report uses national expenditure data to examine and estimate the cost of raising children through age 17 by both two-parent and single-parent families. Adjustment factors for the number of children in the family are also provided.

Since 1960, USDA researchers have provided estimates of child-rearing expenses for major components of the budget by age of child, family income, and region of residence. The estimates do not include the cost of childbearing or the cost of a college education. Some current costs, such as child care, were negligible in 1960.

Results have proven to be a valuable resource to States in determining child support guidelines and foster care payments as well as in family educational programs. A limited number of copies of the report are available to the public at no cost from:

Center for Nutrition Policy
and Promotion
1120 20th Street, NW
Suite 200 North Lobby
Washington, DC 20036

Using the Food Guide Pyramid: A Resource for Nutrition Educators

This report, currently available electronically from the Internet only, provides over 125 pages of detailed information about USDA's research-based food guidance system and includes example menus and recipes. Intended primarily for nutrition educators, the publication illustrates how to use the Food Guide Pyramid to plan and prepare foods for diets that conform to the 1995 Dietary Guidelines for Americans.

Menus for 5 days at each of 3 calorie levels, 23 taste-tested recipes, daily shopping lists, and an expanded list of serving sizes are featured. In addition, the report describes how to count servings from the food groups in menus for a day's diet; how mixed foods and recipe items contribute to food group servings; and how to adapt a menu for individuals who have different calorie/nutrient needs.

Cost of Food at Home at Four Cost Levels

This publication is updated monthly. Cost estimates assume that food for all meals and snacks is purchased and prepared at home. Estimates are prepared at four cost levels for specific age/sex groups and family types. The Thrifty Food Plan shows the minimum cost of a nutritious diet and is used as the basis for the food stamp allotment. The other plans provide a nutritious diet with a different mix of foods.

To download and print any of these publications, connect to the CNPP home page at:

http://www.usda.gov/fcs/cnpp.htm

and select the file you want by title. Adobe Acrobat Reader—the free software needed to view and print these documents—is available within the link to the document. The *Expenditures* file is listed under its own name and as 960401.PDF. The *Resource for Nutrition Educators* is numbered 960201.PDF. *Cost of Food at Home at Four Cost Levels* is 960501.PDF.

From the Office of Analysis and Evaluation, Food and Consumer Service

The Office of Analysis and Evaluation, Food and Consumer Service reports on the following study of interest to the nutrition-related community.

Nutrition Education in Public Elementary and Secondary Schools

The U.S. Department of Education's National Center for Education Statistics (NCES) recently released **Nutrition Education in Public Elementary and Secondary Schools.** This study was jointly sponsored by the Food and Consumer Service (FCS) and NCES under an interagency agreement. The statistical information analyzed and presented in this report is intended for use by USDA's Team Nutrition, whose mission is to improve the health and education of young people by creating innovative public and private partnerships that promote food choices for a healthful diet through media, schools, families, and communities.

The study determined which nutrition education programs and activities are available in schools. Specifically, it examined: (1) topics covered in nutrition education; (2) how schools provide nutrition education; and (3) importance of nutrition education and importance and priority of topics. Data were collected by a mail survey of 1,000 school principals in a nationally representative sample of U.S. public elementary, middle, and high schools. The response rate was 93 percent.

Overall, although nutrition education is already an area of activity in public schools, there is room for additional effort. Opportunities exist for the development of appropriate materials, including those that are age-appropriate and those that are designed to assist teachers in preparing their own nutrition education lessons. Nutrition education could also benefit from greater coordination across different subjects within the curriculum, across grade levels, and between the curriculum and other school resources such as the school meals program. Optimal coordination could ensure that messages received by students are consistent, pervasive, and aimed at motivating children to choose a healthy diet.

Major findings:

Almost all public schools (99 percent) offer nutrition education with many integrating it throughout the curriculum (70 percent). Nutrition education is concentrated in the health curriculum (84 percent), science classes (72 percent), and school health programs (68 percent). The intensity and quality of the nutrition messages students are receiving, however, is not known.

For each grade from kindergarten through 8th grade, 50 percent or more of all schools have district or State requirements for students to receive nutrition education. However, only 40 percent have these requirements for 9th and 10th grades and about 20 percent, for 11th and 12th grades.

Nutrition topics covered by more than 90 percent of all schools are: The relationship between diet and health, finding and choosing healthy foods, nutrients and their food sources, the food guide pyramid, and the Dietary Guidelines. However, with the exception of the food guide pyramid, less than half of schools cover these topics thoroughly.

Overall, schools focus on increasing students' knowledge about what is meant by good nutrition. Four of the five topics covered by more than 90 percent of all schools are related to knowledge. With the exception of finding and choosing healthy foods, less than one-third of schools provide thorough coverage of topics related to motivation, attitudes, and eating behaviors.

The majority of schools (61 percent) have no nutrition education coordinator, meaning each teacher is responsible for his or her own lessons.

Ninety-seven percent of schools report receiving nutrition lesson materials from at least one source outside the school, most often from professional or trade associations (87 percent) and the food industry (86 percent). However, only 37 percent or less of schools used all or most of the materials received from any given outside source. Schools reported the highest classroom usage for materials received from the food industry or commodities groups, professional or trade associations, the USDA Food and Nutrition Information Center, and State education agencies.

Most schools use materials developed by teachers in their schools (90 percent), health or science textbooks (89 percent), and materials developed for a specific grade level (83 percent).

Over 90 percent of all schools offer nutrition education through the school meals program. Most activity, however, is either a bulletin board with nutrition displays (65 percent) or school lunch

week (51 percent). Less than half of school meals programs offer nutrient information, serve meals to correspond with classroom activities, give tours, or provide nutrition input to newsletters. Less than one-quarter of school meals programs provide nutrition education in the classroom or conduct tasting parties.

Most respondents (84 percent) feel that the meals programs in their schools follow generally healthy eating practices. Schools reporting that their meals programs follow healthy eating practices are significantly more likely to be involved in nutrition education activities than other schools.

The final report is available by contacting FCS's Office of Analysis and Evaluation at (703) 305-2017, FCS's Office of Public Information at (703) 305-2276, or Judith Carpenter, NCES, at (202) 219-1333. The report can also be accessed through Internet by the following:

World Wide Web at
http://www.ed.gov:80/NCES/pubs/96852.html(case sensitive)

Internet FTP services at
ftp://ftp.ed.gov/ncesgopher/publications/postsec/ipeds/finance

Call for Papers

We are planning a special issue of *Family Economics and Nutrition Review* that will focus on **international data and themes**. If you are interested in writing for this issue, please send your manuscript to the editor following the guidelines listed on the back inside cover of this issue. Research papers and research briefs will be selected for publication. The deadline for receipt of manuscripts is April 1, 1997.

Data Sources

Health and Retirement Study (HRS)

Sponsoring agency: U.S. Department of Health and Human Services

Population covered: A longitudinal study of persons in the 1931-41 birth cohorts as they enter their retirement years, and their spouses. Blacks and Hispanics were oversampled. In addition, Florida residents were oversampled because of Congressional interest in areas with high densities and numbers of older populations.

Sample size: 12,650 in 1992 and 11,340 in 1994.

Geographic distribution: Nationwide

Years data collected: 1992 and 1994

Method of data collection: Personal interviews in 1992. Computer-Assisted telephone techniques in 1994. Additional information was collected from respondents' employers regarding employer-provided pension plans and health insurance plans with some follow up with the U.S. Department of Labor.

Future surveys planned: Biennial interviews are planned. When eligible, these participants will become part of the Assets and Health Dynamics Among the Oldest-Old (AHEAD) study (see below) that obtains similar information on respondents age 70 and older. New cohorts will be added to the HRS as they reach the 51-55 age range; thus, the HRS/AHEAD will be cross-sectionally representative of the U.S. population over age 50. Linkages to data from social security earnings and benefit histories and to medicare records of respondents are planned.

Major variables: The focus is on interactions of health, economic status, and family behavior with the transition from employment into retirement.

Sources for further information and data:
The Health and Retirement Study
Survey Research Center
3200 Bay, P.O. Box 1248
Ann Arbor, MI 48106-1248
(313) 936-0314
WEB SITE:
http://www.umich.edu/~hrswww
Internet address:
hrsquest@isr.umich.edu

Asset and Health Dynamics Among the Oldest-Old (AHEAD): HRS Auxiliary Study

Sponsoring agency: U.S. Department of Health and Human Services

Population covered: A longitudinal study of persons born before 1924, and their spouses. Blacks and Hispanics were oversampled. In addition, Florida residents were oversampled because of Congressional interest in areas with high densities and numbers of older populations.

Sample size: 7,450 age 70 or over, including 2,550 age 80 and over, plus 775 younger spouses.

Geographic distribution: Nationwide

Years data collected: 1993 and 1995

Method of data collection: In 1993, Computer-Assisted Personal Interviews were completed with 3,200 respondents, mostly 80 years of age and over; Computer-Assisted Telephone Interviews were completed with 4,900 persons, mostly 70-79 years of age.

Future surveys planned: Biennial interviews are planned with all respondents, including a final proxy interview after death. In 1998-99, a new cohort of individuals born in 1924-30 will be added to the study.

Major variables: The focus is on interactions of health, wealth, and family structure in determining the economic welfare of the elderly, and in helping to understand asset spenddown and bequests from the post-retirement period until death.

Sources for further information and data:
The Health and Retirement Study
Survey Research Center
3200 Bay, P.O. Box 1248
Ann Arbor, MI 48106-1248
(313) 936-0314
WEB SITE:
http://www.umich.edu/~hrswww
Internet address:
aheadask@umich.edu

Journal Abstracts

The following abstracts are reprinted verbatim as they appear in the cited source.

Colavito, E. and Guthrie, J.F. 1996. USDA's new Diet and Health Knowledge Survey: How can it be used for theory-based research? *The Journal of the Association for the Study of Food and Society* 1*(1)*:13-22.

Research studies employing major theories of behavior change, such as the Health Belief Model, Rogers' Model of Diffusion of Innovation, and other theories, have added to our understanding of the relationship of knowledge and attitudes to food-related behavior. Unfortunately, many of the studies that employed these models have used small, local samples, limiting the generalizability of their findings. The new Diet and Health Knowledge Survey (DHKS), conducted by the U.S. Department of Agriculture, provides nationally-collected data on knowledge and attitudes concerning diet and health. Linked to dietary data collected from those individuals as a part of USDA's Continuing Survey of Food Intakes by Individuals, the DHKS data can be used to examine relationships between knowledge, attitudes, and food-related behavior, as postulated by behavior change theories, in a large, diverse, national sample of individuals. This article describes the DHKS, discusses its strengths and limitations as a data source for research studies based on major theories of behavior change, and provides some examples of theory-based studies of food-related behavior that could be conducted using DHKS data.

Rimm, E.B., Klatsky, A., Grobbee, D., and Stampfer, M.J. 1996. Review of moderate alcohol consumption and reduced risk of coronary heart disease: is the effect due to beer, wine, or spirits? *British Medical Journal* 312:731-736.

Objectives—To review the effect of specific types of alcoholic drink on coronary risk.
Design—Systematic review of ecological, case-control, and cohort studies in which specific associations were available for consumption of beer, wine, and spirits and risk of coronary heart disease.
Subjects—12 ecological, three case-control, and 10 separate prospective cohort studies.
Main outcome measures—Alcohol consumption and relative risk of morbidity and mortality from coronary heart disease.
Results—Most ecological studies suggested that wine was more effective in reducing risk of mortality from heart disease than beer or spirits. Taken together, the three case-control studies did not suggest that one type of drink was more cardio-protective than the others. Of the 10 prospective cohort studies, four found a significant inverse association between risk of heart disease and moderate wine drinking, four found such an association for beer, and four for spirits.
Conclusions—Results from observational studies, where alcohol consumption can be linked directly to an individual's risk of coronary heart disease, provide strong evidence that all alcoholic drinks are linked with lower risk. Thus, a substantial portion of the benefit is from alcohol rather than other components of each type of drink.

Wolf, A.M. and Colditz, G.A. 1996. Social and economic effects of body weight in the United States. *American Journal of Clinical Nutrition* 63(Suppl):466S-469S.

Given that overweight is clearly associated with increased risk of many major chronic diseases, the United States could have saved ~$45.8 billion or 6.8% of health care expenditures in 1990 alone if obesity were prevented. The question then arises, economically and socially, what is a healthy body weight? Using a prevalence-based approach to cost of illness, we estimated the economic costs (1993 dollars) associated with illness at different strata of body mass indexes (BMIs, in kg/m^2) and varying increments of weight gain to address the questions: At what body weight do we initiate preventive services? What are the direct costs associated with weight gain? Second, using the 1988 National Health Interview Survey (NHIS), we evaluated the marginal increase in certain social indexes reflective of functional impairment and morbidity (ie, restricted-activity days, bed days, and work-loss days) as well as physician visits associated with different strata of BMI. With respect to economic and social indexes, a healthy body weight appears to be a BMI <25, and weight gain should be kept to <5 kg throughout a lifetime.

Cost of Food at Home

Cost of food at home estimated for food plans at four cost levels, September 1996, U.S. average[1]

Sex–age group	Cost for 1 week				Cost for 1 month			
	Thrifty plan	Low-cost plan	Moderate-cost plan	Liberal plan	Thrifty plan	Low-cost plan	Moderate-cost plan	Liberal plan
FAMILIES								
Family of 2:[2]								
20 - 50 years	$56.10	$70.40	$86.70	$107.60	$243.10	$305.10	$375.80	$466.20
51 years and over	52.80	67.70	83.50	99.90	228.60	293.10	361.50	433.00
Family of 4:								
Couple, 20 - 50 years and children—								
1 - 2 and 3 - 5 years	81.80	101.70	124.10	152.50	354.30	440.90	538.10	660.60
6 - 8 and 9 - 11 years	93.90	119.80	149.30	179.70	407.20	519.10	646.80	778.30
INDIVIDUALS[3]								
Child:								
1 - 2 years	14.80	18.00	21.00	25.50	64.00	78.00	91.10	110.30
3 - 5 years	16.00	19.70	24.30	29.20	69.30	85.50	105.40	126.50
6 - 8 years	19.60	26.10	32.60	37.90	85.10	113.20	141.20	164.00
9 - 11 years	23.30	29.70	37.90	44.00	101.10	128.50	164.00	190.50
Male:								
12 - 14 years	24.10	33.50	41.50	48.80	104.40	145.20	179.70	211.60
15 - 19 years	25.00	34.50	42.90	49.70	108.20	149.70	185.90	215.20
20 - 50 years	26.80	34.10	42.60	51.50	116.20	147.90	184.60	223.30
51 years and over	24.20	32.50	40.00	47.90	104.90	141.00	173.20	207.60
Female:								
12 - 19 years	24.20	28.90	34.90	42.20	104.90	125.00	151.30	182.70
20 - 50 years	24.20	29.90	36.20	46.30	104.80	129.50	157.00	200.50
51 years and over	23.80	29.00	35.90	42.90	102.90	125.50	155.40	186.00

[1]Assumes that food for all meals and snacks is purchased at the store and prepared at home. Estimates for the thrifty food plan were computed from quantities of foods published in *Family Economics Review* 1984(*1*). Estimates for the other plans were computed from quantities of foods published in *Family Economics Review* 1983(*2*). The costs of the food plans are estimated by updating prices paid by households surveyed in 1977–78 in USDA's Nationwide Food Consumption Survey. USDA updates these survey prices using information from the Bureau of Labor Statistics, *CPI Detailed Report*, table 4, to estimate the costs for the food plans.

[2]Ten percent added for family size adjustment. See footnote 3.

[3]The costs given are for individuals in 4-person families. For individuals in other size families, the following adjustments are suggested: 1-person—add 20 percent; 2-person—add 10 percent; 3-person—add 5 percent; 5- or 6-person—subtract 5 percent; 7- or more-person—subtract 10 percent.

Consumer Prices

Consumer Price Index for all urban consumers [1982-84 = 100]

Group	Unadjusted indexes			
	September 1996	August 1996	July 1996	September 1995
All items	157.8	157.3	157.0	153.2
Food	154.6	153.7	153.2	148.9
Food at home	155.9	154.8	154.1	149.2
Food away from home	153.5	153.1	152.8	149.6
Housing	153.9	154.0	153.6	149.5
Shelter	172.0	172.3	171.9	166.8
Renters' costs[1]	180.9	183.4	183.0	175.1
Homeowners' costs[1]	177.5	177.0	176.6	172.4
Household insurance[1]	162.3	162.3	162.0	157.0
Maintenance and repairs	139.9	139.7	139.4	135.4
Maintenance and repair services	147.4	147.1	146.3	140.3
Maintenance and repair commodities	129.5	129.6	130.1	128.9
Fuel and other utilities	129.8	129.4	129.0	124.9
Fuel oil and other household fuel commodities	95.6	92.2	92.3	86.6
Gas (piped) and electricity	126.2	126.1	125.6	121.6
Household furnishings and operation	125.1	124.8	124.7	123.8
Housefurnishings	111.5	111.3	111.2	111.7
Apparel and upkeep	131.5	128.1	128.3	132.7
Apparel commodities	127.8	124.2	124.5	129.5
Men's and boys' apparel	127.4	126.2	125.1	126.8
Women's and girls' apparel	123.6	118.1	118.5	126.9
Infants' and toddlers' apparel	131.4	125.1	125.7	131.2
Footwear	126.7	124.7	125.6	126.8
Apparel services	160.4	160.3	159.9	157.4
Transportation	143.2	142.8	143.5	138.8
Private transportation	140.0	139.9	140.5	135.9
New vehicles	143.2	142.9	143.2	140.0
Used cars	157.0	156.6	156.9	156.5
Motor fuel	106.2	106.4	108.9	99.8
Maintenance and repairs	160.0	158.6	158.1	155.1
Other private transportation	174.1	174.1	173.5	170.1
Public transportation	184.6	181.4	182.7	176.1
Medical care	229.4	229.2	228.7	222.1
Medical care commodities	211.2	211.1	211.0	204.8
Medical care services	233.6	233.4	232.9	226.1
Professional medical services	209.6	209.2	208.7	202.4
Entertainment	159.8	159.2	159.0	154.9
Entertainment commodities	143.3	143.2	142.9	139.3
Entertainment services	179.1	178.0	178.0	173.4
Other goods and services	218.3	216.3	214.6	210.2
Personal care	150.8	150.5	150.0	147.5
Toilet goods and personal care appliances	145.1	145.0	144.4	143.0
Personal care services	157.2	156.5	156.3	152.4
Personal and educational expenses	252.1	248.7	245.8	240.7
School books and supplies	229.9	227.6	224.7	216.9
Personal and educational services	254.0	250.5	247.6	242.7

[1]Indexes on a December 1982 = 100 base.

Source: U.S. Department of Labor, Bureau of Labor Statistics.

Index of Authors in 1996 Issues

Index of Articles in 1996 Issues

*Indicates article was abstracted from another source.

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